Safety design integrated in the Building Delivery System

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TOWARDS SAFETY THROUGH ADVANCED SOLUTIONS

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KEYNOTE LECTURES

KL1: Managing safety critical organizations – lessons from the health care and nuclear domains

Teemu Reiman – VTT Technical Research Centre of Finland, Finland

The presentation focuses on research conducted at two different domains, nuclear power production and health care. In the context of health care I have, with my colleagues Elina Pietikäinen and Jouko Heikkilä, studied the challenges of patient safety management in the changing landscape of healthcare services. In the nuclear power production I have, together with Carl Rollenhagen, studied tensions and trade-offs in safety management. I will abstract some key lessons about managing safety critical organizations based on the aforementioned studies.

Management of safety depends heavily on two things: how we view safety and how we view the system the property of which safety is. Recent theories on system safety emphasize that safety is more than the negation of risk. Safety is a complex, systemic phenomenon, the analysis of which requires understanding the social dynamics of the organization in question. System safety (i.e. nuclear safety, patient safety) is created every day in the interactions of individual professionals, technology, units and organisations. Safety cannot be understood or managed by understanding or managing its constituent parts in isolation.

Managing safety in complex sociotechnical environments has been conceptualized as culminating in the problem of system control (Rasmussen 1997). The system should be controlled in such a manner that it remains within the boundaries of its envelope of safe performance. However, recent formulations of industrial systems as complex adaptive systems emphasize the impossibility of controlling them. These theories refer to concepts such as self-organization and emergence as inherent characteristics of our organizations. These theories also challenge our notions of safety management as building on implementation of barriers, procedural adherence, quality control, clear distribution of responsibility and supervision. Even the idea of hierarchical management has been complemented with the notions of distributed control and shared leadership. If we accept the systems view on safety and safety-critical organizations, the management of safety should focus on increasing the capability of the organization to cope with the work on a daily basis, in addition to constraining unwanted variability with safety barriers, standardization and redundancy. Safety management in complex sociotechnical systems requires several seemingly contradictory approaches: a) defining boundaries and limits to

the system and at the same time creating capability for the system to self-organize, b) strengthening of interaction and processes within the system and at the same time focusing on outcomes and interaction outside the formal system boundaries, and c) formulation of current guiding principles and envisioning possible futures of the system.

In conclusion, I propose that safety management needs to focus on creating potential for safety in the organization. This potential may or may not actualise as safe situational actions. This is due to the fact that complex system cannot be controlled in the traditional sense of the word control, i.e. exercising restraints and direction over the outcomes of the system. There is always unpredictability in the outcomes of a complex adaptive system. Rather than seek to reduce the complexity of organizations safety management should seek to offer the personnel the means to cope with the complexity.

KL2: Safety management and culture in health care

Rhona Flin – University of Aberdeen, Scotland, UK

Recent concern regarding the levels of adverse events (iatrogenic injury) to patients in our health care systems has resulted in the adoption of a number of safety management approaches from the industrial sector. One aim of these interventions is to improve the safety culture of hospitals and other clinical work settings. Many safety-critical organisations regularly measure their safety culture using staff surveys and this practice is becoming more widespread in healthcare. As safety culture is essentially about the norms of behaviour occurring in each work unit, it is also important to focus on managers' and clinicians' behaviour as one route to cultural change. The design and implementation of non-technical skills training and related behavioural rating tools such as NOTSS for surgeons, ANTS for anaesthetists and SPLINTS for scrub nurses (see www.abdn.ac.uk/iprc) is one example of this approach. In this presentation, I will examine how recent advances in clinical simulation (e.g. for operating theatre teams), with a focus on these non-technical skills, may be an alternative method of collecting cultural data and also for shifting accepted behavioural norms in a safer direction.

KL3: The underlying causes of serious occupational accidents

Linda J. Bellamy – White Queen BV, The Netherlands

There are lessons to be learned from analysing large numbers of accidents in order to find patterns of underlying causes to identify where preventive effort should be focused. The

development of accident databases serves this purpose, providing users with a wider insight based on statistical evidence of dominant causes and of case studies which tell the detailed stories of how accidents arise.

In this presentation examples will be given from a database called Storybuilder™ showing that serious accidents are largely preventable. Detailed investigation reports and witness statements have been analysed according to a human-technical model which reflects the evolutionary periods of modern safety science focusing first on technology caused problems then human error followed by attention to safety management. The database is used to answer questions about accident causation.

So far the database contains 22,858 serious accidents occurring between 1998–2009 with 23,618 victims of whom 897 died and 8,263 were permanently injured. The modeling of all these scenarios is done graphically in 36 hazard bowties. The technical system is represented by safety barriers which have been identified as having failed. The human system comprises front line tasks serving those barriers and management delivery systems resourcing those tasks. Successes and failures are recorded for each accident together with other information such as activities and equipment. The data show that different hazards have different patterns of underlying causes suggesting they need to be resourced and managed differently but that there are some archetypal characteristics across many hazards like:

A. Inadequate safeguarding (restraints, physical barriers, isolation, lock-out) in the danger zone.
B. Not keeping people or parts of their body out of the danger zone (body position).
C. Not delivering the appropriate skills and awareness, equipment and procedures to the tasks (using the right methods and tools).

Because so many accidents have been analysed it is possible to distill these kinds of shortlists of ABC's which are key causes that underpin the majority of accidents as a whole or of sub groups like young persons, the building sector, working with forklifts as well as specific hazards like falls from roofs, human aggression, working with moving machinery. Regulators, industry sectors and companies can then use these data in their prevention programs.

KL4: The competency gap: the failure of regulation in workplace safety

Chris Johnson – University of Glasgow, UK

In many European industries, there are no consistent competency criteria for the regulators who ensure workplace safety. In consequence, some member states have well paid, knowledgeable and competent regulators. Unfortunately many other countries are

less fortunate. These problems are compounded when state employees are paid much less than operational staff. There is little chance of attracting the best people to move into regulatory agencies. Further problems are created by cross-modal regulation. This avoids bias by ensuring that regulators do not oversee the workplace safety of organisations in those industries where the regulators have previously been employed. Unfortunately, this often creates a situation where regulators lack the detailed engineering, technical and working insight that is required to understand the processes that they must oversee. Many of these problems have been made far worse by the financial crisis that has affected most European countries over the last two years. However, similar criticisms can also be applied to North American regulatory agencies.

This paper will describe the regulatory crisis that is facing many process industries – where companies cannot obtain the guidance that they expect and require from state agencies. We will go on to propose competency criteria that can be used to assess whether regulators are fit to protect workplace safety across a range of different industries.

KL5: The ETPIS SafeFuture initiative: safe innovation for sustainable and competitive future

Olivier Salvi – European Technology Platform on Industrial Safety (ETPIS)

Industrial Safety constitutes a cross-cutting field of knowledge which provides an important added value in all European industry sectors, especially with the aim to **develop sustainable technologies and products**. Safety, security and sustainability are considered as key factors for successful business and an inherent element of business performance.

The European Technology Platform on Industrial Safety has structured its contribution to support the EU2020 Strategy with the SafeFuture initiative, focusing on the sustainability and competitiveness targets of the European Union.

SafeFuture aims at improving the competitiveness of European industry and generating knowledge in industrial safety to ensure its transformation from a resource-intensive to a knowledge-intensive base, by creating step changes through research and implementing decisive knowledge for new applications at the crossroads between different technologies and disciplines. This will benefit both new, high-tech industries and higher-value, knowledge-based traditional industries, with a special focus on the appropriate dissemination of RTD results to SMEs.

SafeFuture has been developed with a top-down approach, taking into account the top priorities expressed by ETPIS High Level Group gathering representatives from several industry sectors (energy, construction, manufacturing, chemical, and (re-)insurance) and focusing on the EU Grand Challenges such as the climate change, greening of transport, sustainable energies...

It is described in an introduction document presenting the general approach and in a Strategic Research Agenda 2020, which is being elaborated through a collaborative work. The SRA 2020 will be used to input the Horizon 2020 programme of the European Commission.

SafeFuture initiative is structured around 4 pillars:

- Safe Infrastructure, to address e.g.: life extension of process plants, transport infrastructures, power plants, off-shore platforms...; intensification of Natural catastrophes due to climate change; design and monitoring for long term operation for Carbon Capture and Storage; protection and security of critical infrastructures...
- Safe Energy, to address e.g.: safety of the use of new energy carriers for vehicles (FEV, fuel cells, CNG, biofuels...); safety for the green energy technologies (wind mills, photovoltaic panels, concentrating solar power (CSP)...); making the underground transport infrastructure compatible with the new energy carriers; combining pan European transport infrastructures and smart high power electricity grids...
- Safe Products and Production, to address e.g.: development of the European Factory of the Future, by managing emerging risks through new integrated solutions (safety systems, advanced personal protective equipments, new organizational models, ergonomics, etc.); enabling higher productivity under better workplaces; safety for the green jobs; safe production and use of nanomaterials...
- Transversal issues, to solve existing challenges for sustainable integration, interaction and risk governance such as: difficulties in putting together different risk mitigation policies and ensuring their compatibility (Risk-Risk trade-offs), Multi-risk and interdependencies of risks in a global competitive market...

More information at: http://www.industrialsafety-tp.org/

KL6: Application of advanced PPE for accident prevention

Katarzyna Majchrzycka – Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Poland

There exists a considerable number of professions where risk cannot be reduced or eliminated by the use of technological or organizational means. Such activities call for the use of personal protective equipment (or PPE as it is commonly known). However, in the course of a work activity, PPE exerts additional load onto the worker's body and therefore requires the employer to undertake various preventive measures. Apart from obvious ones aimed at removing the damaging agents, much emphasis must be put on such issues as, e.g. specifying the safe use of PPE or the guaranteed level of security in the changeable conditions characteristic of the workplace.

In light of the above, advanced PPE, alongside its high protective quality, ought to be a source of information supporting the user in taking decisions with regard to the evaluation of the potential danger and, if possible, in responding to the changeable conditions of the workplace. To satisfy those requirements, it is necessary to use state-of-the art technology, especially nanomaterials, textronics, smart electronic systems that would be able to process the signals according to the assumed algorithms. In extreme conditions of use, PPE should be connected with the data managing centre supervising the level of physiological parameters of the user and the current control of the level of danger in the environment. In this context, the Augmented Reality (AR) technique should be used to visualize the physical threats.

This document presents basic trends in development of particular types of PPE. It concentrates especially on solutions with regard to protective clothing, protection of hands and feet, where a particular emphasis is put on producing clothing which ensures the sense of comfort and optimal functioning for the user as well as application of new composites, intelligent textiles and nanotechnology. As for respiratory protective equipment and equipment protecting against falls from heights, directions in development of this equipment are discussed. Furthermore, the use of new construction elements and electronic systems is underlined. Such solutions will serve to inform the user of any changes in protective features and/or usage during the time of using those agents. Finally, the directions for future research also include product customisation, new training methods and aids as well as the issue of possible integration of smart PPE systems with other safety measures.

KL7: Promoting safety by increasing uncertainty

Gudela Grote – Swiss Federal Institute of Technology (ETH), Switzerland

Fukushima has shown once again how fickle our presumed mastery of technological risk is. The expert report on the causes of the nuclear disaster point to a lack of tolerance for ambiguity and uncertainty in the Japanese culture which prevented proactive handling of uncertainties. In the talk some fundamental features of risk perception, decision-making under uncertainty and organizing for high reliability are presented and consequences for individual, organizational, and societal risk management discussed. Conclusions drawn concern designing socio-technical systems in view of limits of control and achieving safety by increasing rather than reducing uncertainties (e.g. be means of flexible rules, empowering people to speak up, and breaking routines). Finally, balancing risk and safety also requires a more courageous public understanding of living with risk and forms of risk communication that support this courage instead of frightening or belittling all of us.

PARALLEL SESSIONS

Parallel session TS1: Major accident analyses and prevention

TS1

1. How hindsight bias distorts history. An iconoclastic analysis of the 2005 Buncefield explosion

Richard T. Booth – Aston University, Health and Safety Technology and Management Ltd (HASTAM), UK

The paper reviews hindsight bias in the context of the 2005 Buncefield explosion. Hindsight bias promotes the belief that adverse events are more foreseeable than they really are. Moreover errors seem more culpable with knowledge of their serious consequences. Incident investigators are wrong in believing that they have 'factored out' the bias in their enquiries. Suggestions are made to minimise the bias in investigations.

The Buncefield explosion at Hertfordshire Oil Storage Ltd (HOSL) followed an overflow of petrol from a storage tank. Total UK Ltd (TUKL), with Chevron were the joint owners of HOSL. TUKL were prosecuted following the explosion. The author was engaged by TUKL as an expert witness to assist the court. I view the case now from the perspective of TUKL, but with the aim of objectively, though this is for others to judge.

TUKL were accused of inadequate safety oversight of HOSL. In fact TUKL were adopting good practice, including engaging DNV auditors. But these practices failed to detect shortcomings in the operational safety arrangements of their subsidiary. The prosecution claimed that because these procedures failed this was 'proof' that the procedures were inadequate. TUKL were also blamed for not foreseeing an explosion, perceived as not "realistically credible" pre-event.

Good practice in the safety oversight of subsidiary companies may be deficient generally. TUKL had valid reasons for believing that their systems were robust. But their "reach" was deficient – operational matters were not adequately covered. However shortcomings in shift record keeping and handovers at HOSL have also been a causal factor in many major explosions.

Hindsight bias distorts the findings of incident investigations generally, and the paper suggests how the malignancy of the bias can be minimised, and the correct lessons learnt.

Keywords: Hindsight bias, buncefield, major incident inquiry board, auditing, COMAH, shift record-keeping

TS1

2. Can near miss reporting prevent accidents? A case study from the oil and gas industry in Denmark

Hanna Barbara Rasmussen – Centre of Maritime Health and Safety, Johnny Dyreborg – National Research Centre for Working Environment, Denmark

Background: The oil and gas industry in the Danish sector on the North Sea has always focused on reducing work related accidents. Over the years accident rates have been reduced to 2.3 per million working hours in total (2010). Near miss reporting is considered important in order to prevent accidents. That is why the oil and gas companies use a lot of resources to register and analyse near misses. The aim of this paper is to investigate the near miss reporting procedures on Danish off-shore installations, in order to investigate what the industry learns from near miss reporting, and the potential challenges and barriers in using this information for the further prevention of accidents.

Data: Material consists of documentary data such as procedures, rapports etc. as well as interviews and a databases including information on near misses. Data derive from three oil and gas companies in the Danish sector of the North Sea. The near misses have been divided into thematic groups, and two types of near misses were chosen for further analysis.

Methods: Thematic analyses of documentary material, accidents prevention procedures and chosen near miss cases.

Preliminary results: The preliminary results show that all companies have a procedure regarding how to register accidents and near misses and guidelines which describe how to register and handle accidents and near misses. The paper will present results on the challenges and barriers for improving the use of near misses in the prevention of accidents on off-shore installations.

Keywords: Near misses, accident prevention, offshore

TS1

3. Participatory safety barrier analysis: A case from the offshore maritime industry

Trond Kongsvik, Torgeir Haavik, Gudveig Gjøsund – Norwegian University of Science and Technology (NTNU Social Research), Norway

This paper argues that a participatory approach directly involving employees in safety barrier analysis can provide "added value" to traditional barrier analyses. Employee

participation (EP) could motivate employees to use their knowledge, suggest improvement measures and express their concerns. EP has not received much attention from safety researchers, although one may find several indirect arguments for EP informing the influential safety theoretical perspectives. An example of how participatory safety barrier analysis can be completed and what can be accomplished through such an approach is illustrated via a case study from an offshore logistics chain, and by an analysis of barriers that should prevent collisions between supply vessels and offshore installations. Such collisions could be the initiating event for a major accident. The empirical foundation for the paper is a HAZID session, group and individual interviews, document studies and two search conferences involving approximately 150 participants. It is argued that a participatory approach to safety barrier analysis can reveal "holes" in the defences that otherwise could have gone overlooked, and contribute to the generation of contextualized, definite measures that could strengthen a safety barrier system.

Keywords: Barrier analysis, participation, maritime, action research

TS1

4. Identification and analysis of commonalities among 3 global offshore drilling incidents

Ole Andreas H. Engen, Kathe-Marie Solberg Hansen – University of Stavanger, Norway

The objective of this paper is to evaluate the organizational aspects of three drilling accidents/incidents taking place in 2010. Gullfax Well 34/10-C-06A, Montara WHP and the Macondo blow-out. Even though all three events have been subject of thorough investigations, there is a need to more specifically analyze these events as organizational accidents and further examine general organizational features characterizing these accidents. Even though the cases are different, they may exhibit common traits concerning incidents and accidents in the international petroleum industry. Our ambition is to highlight organizational themes which seem to be common features amongst the cases and thus address the gaps between the safety ambitions, in form of establishment of e.g. rules and routines and procedures. Our analysis will contribute to reveal possible pitfalls when relying on safety through a system perspective without paying attention to its human interrelationship, especially those in the "sharp end" i.e the drillers themselves.

By understanding the three incidents as organizational matters, one can identify several common organizational features contributing to explain how the incidents occurred and their chain of events. From the official incident reports, we have extracted five relevant

organizational issues that not only contribute to understand the actual incidents, but also make it possible to reflect upon whether these factors have more general validity explaining accidents in the petroleum industry. The five organizational aspects are *Compliance, Communication, Procedures, Competence and Management*. All categories have in common that they deal with identified deviations or complications. In accordance with the applied organizational categories, identified errors and definiteness may either appear as direct or intermediate explanations. Moreover, the aspects may also interrelate and thus explain discrepancies among each other.

Parallel session TS2: Accident statistics and safety performance

TS2

1. Accident causation of severe and fatal accidents in Andalusian Manufacturing Sector

Jesús A. Carrillo, Luis Onieva – University of Seville, Juan C. Rubio-Romero – University of Málaga, Spain

The main purpose of this paper is to identify the most frequent causes of accidents within the manufacturing sector in Andalusia in order to orientate safety practitioners in the task of prioritize the preventive actions. The analysis is based on official accident investigations in the period from 2004 to 2011. Learning from accidents can help to fill the gap between risk assessment and safety interventions.

Analyzing the proportion of each type of causes identified in each case, we found evidence of the differential causation between slight and non-slight accidents. Besides, ss there are only available enough investigations for non-slight accidents, we based the research on the official accident investigations of 390 severe and fatal accidents in the manufacturing sector of Andalusia, one of the biggest regions in Europe, in the period from 2004 to 2011. The methodology of accident investigation is based on a fault tree model. Codification of each accident is based on a list of 255 possible cause codes grouped as workspace conditions, protection and service installations, machines, other equipment, materials and substances, work organization, safety management and personal factors.

Some specific types of latent causes have a significant relationship with specific active (immediate) causes. These relationships identify the underlying mechanism that explains the way organizational and safety management contribute to prevent the active failures.

We also have encountered significant differences in accident causation depending on the mechanism of the accident. These results can be used to prioritize preventive actions oriented to fight the most likely causes of each accident mechanism.

Another important finding is the inappropriate application of the preventive principles of the European Safety Framework Directive. In most of accidents, we found failures in hazard identification, definition of preventive actions and lack of adequate implementation. Small and medium enterprises fail more frequently in implementing preventive actions than big enterprises.

TS2

2. Circumstances and causes of accidents in Maintenance Operations: Research to practice approach

Jesús A. Carrillo, Luis Onieva – University of Seville, Juan C. Rubio-Romero – University of Málaga, Spain

Maintenance safety has been the topic of the last European Campaign on health and safety at work. Although in previous research on maintenance accidents there is useful information about main circumstances of fatal and severe accidents, in our data we have identified main circumstances not only of severe and fatal maintenance accidents but also of slight ones.

With the objective of providing useful data for safety practitioners, we have analyzed 7,688 reported accidents in manufacturing sector enterprises in Andalusia from 2003 to 2008 with maintenance as working process. We have structured the analysis based on the concepts of task and accident mechanism. Those concepts, implicit in accident report codification according to European Statistics of Accidents at Work methodology, are the key link with actual risk assessment.

We have applied a semi-quantitative risk assessment method based on BS 8800:2004 to the data from accidents in the five tasks with more prevalence in maintenance operations (79.5% of all maintenance accidents are included). As we do not have information of the real exposure, probability of each accident mechanism is based on the real distribution of different accident mechanisms within each task. Severity is estimated based on the expected proportion of severe accidents in each accident mechanism.

Finally, in order to link risk assessment to the causes of accidents, we have analyzed 58 official severe and fatal accident reports of maintenance accidents that happened between 2004 and 2011 in Andalusia. The percentage of latent causes (71%) shows that it is necessary to intervene in organizational and safety management in order to fight the causes of maintenance accidents. Correspondence analysis and contingency tables show that there are causes and deviations with stronger affinity and correlation. Intervention in those pairs of "group of causes deviation" is likely to be effective.

TS2

3. To reduce and prevent injuries related to forklift trucks

Tore J. Larsson – School of Technology and Health KTH, Royal Institute of Technology, Cecilia Oldertz – National Social Insurance Board, Lars-Gunnar Lindberg – AFA Insurance, Sweden

All nationally reported and compensated severe injuries related to industrial lift trucks in Sweden in 2005, 2006 and 2007 has been analyzed in-depth with the help of textual analysis (SAS Textmining).
The results, in terms of distributions over industry, occupation and exposure scenario indicate that

- „driving the truck" is the most prominent exposure scenario in all industries and among all occupations
- most of the injuries associated with „driving the truck" indicate design failings.

Inspection and prevention activities in relation to industrial lift trucks are almost solely concentrated to driver behavior and training.

It is argued that the safe design of the industrial lift truck, and the provision of passive and active safety systems similar to the ones successfully introduced in the modern family car, would reduce and prevent severe injuries associated with industrial lift trucks considerably.

TS2

4. Contributing factors and prevention measures for caught in between fatalities

Chi Chia-Fen, Lin Syuan-Zih, Dwinta Utari – National Taiwan University of Science and Technology, Taiwan

Contributing factors to 287 caught in between fatalities have been identified with respect to individual factors (age, experience, and gender), task factors (performing task), part of body injured, source of injury, and accident causation. Cramer's V and Phi coefficient analysis, based on Chi-square, were used to examine the relationships between factors. Accident scenarios were derived from itemization of accident reports. Broad picture of what exists according to how frequently the occurrence from each contributing factor is obtained in this study. Caught in between fatalities mostly occur in age 25 to 34 years old (29.97%). 263 cases (91.6%) of caught in between fatalities did by male worker. The biggest number of fatalities was contributed by workers with experience only 0 < to > 1 years (38%). Worker performed setting up task contributed the highest number in caught in between fatalities (11.8%) followed by repairing operation and routine operation which given (10.8%) each. Head is the

mostly part which is injured by caught in between fatalities with 79 cases (27.5%). Accident causation divided into 4 parts, unsafe acts, unsafe machinery and equipment, unsafe environment, and unsafe management. The most frequently unsafe acts are servicing of equipment in operation (18.14%) and taking unsafe position or posture (11.56%). In unsafe machinery and equipment, unsafe environment, and unsafe management, the most frequently are inadequate guard (17.9%), poor floor condition (4.08%), and lack of SOP (4.08%). Significant linkages were found between accident causation for caught in between fatalities and source of injury. Safeguarding prevention measures that can be used to prevent caught in between fatalities are suggested in each type of source of injury. Safeguarding prevention measures are barrier guard, safeguarding devices, awareness means, training and procedures, personal protective equipment.

TS2

5. HSE at work within construction and health care

Thale Kvernberg Andersen, Kari Skarholt, Lisbeth Hansson, Lilian Leistad, Mariann Sandsund – SINTEF Technology and Society, Stian Antonsen – Safetec Nordic, Norway

The growth of network organisations, such as contractor hierarchies and outsourcing of ancillary services, is a dominating trend in Western working life and has been so for the last two decades. Another trend is lean organising. These trends represent fundamental changes in the organisation of work and influence on employees' work conditions.

This paper discusses the effects of these organisational structural changes on work conditions and health, safety and environment (HSE). We use sickness absenteeism statistics as an indicator of detrimental HSE conditions in the workplace, which are then operationalised through psychosocial and physical strain.

To explore this topic we present and discuss findings from a study of work conditions within health care and construction in Norway. The health care sector and construction industries are characterised by demanding work conditions that represent a challenge for HSE. The health care sector is dominated by female workers and a high level of sickness absenteeism, mainly caused by musculoskeletal disorders. The construction industry is characterised by complex contractor hierarchies where total entrepreneurs buy services from contractors and sub-contractors. Work conditions and HSE conditions may vary across the contractor hierarchy, and are influenced of whether you are in the top or at the bottom of the hierarchy. Similar to health care, sickness absenteeism is mainly caused by

muscular and skeletal problems. Temporary employment has increased within both these sectors.

The study is based on both qualitative data; semi-structured interviews, and quantitative data; combining data from the Norwegian Register of Employers and Employees with the Norwegian Sick Leave Register, according to occupation, industry and sickness absenteeism.

Parallel session TS3: Safety culture

TS3

1. How are psychosocial risks actually managed in EU workplaces: A secondary analysis of ESENER data

Małgorzata Milczarek, Xavier Irastorza, William Cockburn, Eusebio Rial González – European Agency for Safety and Health at Work

There is a growing body of evidence showing negative effects of a poor psychosocial environment on individual and organisational performance. When demands at work exceed an individual's ability to cope with them, a stress response is triggered off, often leading to behavioural changes such as proneness to mistakes and accidents. Current changes in the working life and economic climate may additionally intensify the problem. The latest, 5th European Working Conditions Survey (2010) shows that 62% of workers reported having to work to tight deadlines, 59% working at high speed almost all of the time, and 45% of workers experiencing significant organisational change (such as restructuring) during the previous 3 years.

The European Survey of Enterprises on New and Emerging Risks (ESENER) carried out by EU-OSHA in 2009 revealed that 79% of European managers voice their concern about stress at work, however, it is rare for enterprises, especially for SMEs, to integrate psychosocial risks into the general OSH management. ESENER shows that less than 30% of EU organisations have procedures in place to deal with stress, workplace violence and harassment. The further analysis of ESENER findings suggests nevertheless that there is a tendency among European enterprises (also among smaller establishments) to manage psychosocial risks using a coherent, systems-based approach. Key drivers for taking action indicated in ESENER across all establishments were requests from employees or their representatives and a desire to reduce absenteeism. The most important barriers to managing psychosocial risks were lack of technical support and guidance, and after launching the process of management, lack of resources and sensitivity of the issue.

To encourage wider uptake of a systematic approach to psychosocial risk prevention, attention should be given to provision of practical guidance, as well as supporting the evidence of an impact of psychosocial risks on accidents and absenteeism at work.

TS3

2. Offshore safety regimes – a contested terrain

Preben H. Lindøe, Ole Andreas H. Engen – University of Stavanger, Norway

After the Macondo accident in the Gulf of Mexico in 2010, the question of robust risk regulation for offshore oil and gas production has appeared on the political agenda not only in US but also in EU as well as other oil and gas producers. Key elements in the recently proposed EU-regulations seem to be in conflicts with the safety regime developed in the North Sea after major accidents in the 1980s (Alexander Kielland and Piper Alpha). The purpose of the paper is to identify and compare these the key elements in the approaches taken by EU compared to the UK and Norwegian offshore risk regulation. The "North Sea" approach dealing with the regulation of working environment and occupational health and safety (OHS), which emerged during the 1970s has regarded both innovative and future-oriented. It is based on the "Nordic model" with labour contract negotiations and a tripartite system involving employer, employees and government. This element is not part of the new EU approach, and the consequence may be a fragmentation of regulations as has been the case in US. The factors to be considered are (1) the (historical) effect of major accidents (2) political-administrative and legal (3) industrial and labour relations and (4) environmental issues. Multiple sources of information provide the empirical basis for the analysis; a portfolio of research projects on the Norwegian and UK context related to technological change, safety management and regulation, legal documentation and key documents in the aftermath of the Macondo disaster.

Keywords: Offshore safety regulation, Nordic model, regulatory change

TS3

3. The tricks of the trade: lessons from the program Improving Occupational Safety

Frank Guldenmund – Delft University of Technology, The Netherlands; Andrew Hale – Health and Safety Technology and Management Ltd (HASTAM), UK

In a project supported by the Dutch Ministry of Social Affairs and Employment 16 diverse Dutch companies were followed for a period of five years after they had introduced safety culture and management changes to improve safety performance. Their performance over those 5 years was compared with a baseline of 3 years before the interventions started. This paper analyses the latest performance measurements to discover if improved companies sustain their performance or drop back, and whether early non-improvers do improve with longer time. It points to the negative effects of the longer term financial and

business downturn, the importance of continuing creative and motivational input from safety professionals to the top management and the line, the crucial role of top management attention and drive, based on those managers having a clear idea of what factors drive safety performance, and the need for anchoring change in safety management structures and continuing efforts to sustain safety culture through measures to promote and reward dialogue between the shop floor and supervision about safety improvements. About half of the companies showed significant long term improvement, either in lost-time accident frequency or in some other measure of behavioural or organisational performance improvement, but in only three was there a continual improvement over the full 5 years. Others showed initial success followed by loss of some of the ground gained, or were late flowerers.

TS3

4. Promoting safety on the shop floor – how does the supervisor's tool box work in practice?

Riikka Ruotsala, Hanna Uusitalo – Finnish Institute of Occupational Health (FIOH), Finland

Supervisors play an important role in realizing the goals and procedures of safety and well-being at workplaces. Today, especially in larger organizations, the promotion of safety and well-being covers wide-ranging areas of activity, such as preventing occupational accidents and diseases, maintaining employees' work ability and developing their professional skills. In order to successfully carry out these practices, supervisors are equipped with numerous tools: risk assessments, accident investigations, incident reports, workplace audits, developmental discussions, and so forth.

From the supervisors' perspective, the issue is not so much the lacking contents of the tool box than the functioning of the whole instrument in practice. In larger organizations, the tools typically originate from different business-supporting expert functions such as safety organization, human resources and occupational health services. These functions – even when operating within a single organization – have their own historically developed theoretical foundations, aims and practical models. These separated activity concepts may lead to overlapping forums and tools, and asynchronized practices (Launis & Pihlaja 2007).

The research interest of the ongoing activity theoretical study (e.g. Engeström 1987) focuses on how supervisors promote safety and well-being in their daily work and what tools they use. The empirical case in the analysis concerns the interplay between supervisors' work and the inter-professional collaboration of service functions in a global industrial corporation. The business unit examined in more detail is a technical textile

manufacturing facility located in Finland. The presentation will answer the following questions: How does the supervisors' tool box support the promotion of safety and well-being at work? How do the different organizational functions serve supervisors in their task?

TS3

5. Facilitating for cultural change: Lessons learned from a 12-year safety improvement programme

Anniken Solem, Trond Kongsvik – Norwegian University of Science and Technology (NTNU Social Research), Norway

In this paper we will present and discuss a safety development program conducted in the period from 2001 to 2012, involving offshore service vessels and the petroleum company that contracts them. In this period there has been a considerable reduction in serious personal injuries and collisions. We present and discuss the underlying approach for the program and how it could have influenced the positive safety results.

There are different views on the extent to which safety culture can be influenced and changed. Researchers within a functionalist perspective regard cultural change to be possible by different management interventions, whereas researchers with an interpretive perspective see culture as more of an abstraction of deeply rooted conceptualizations of meaning and world views, created and recreated by all members of an organization. Consequently, culture is regarded as a concept beyond direct control, although it to a certain extent can be influenced indirectly.

The approach applied in this project had an interpretive perspective as a starting point, using group facilitation as an aid in safety improvements. Facilitators are usually neutral outsiders, and their main task is to help a group increase its effectiveness by improving its process and structure. We established an arena (Captains Forum) where captains and personnel from the petroleum company met for two days once a year, where we facilitated open discussions on safety issues.

The group facilitation approach and connected activities are presented and discussed, as well as the potential influence such an approach could have in changing aspects of the safety culture.

Parallel session TS4: Learning from accidents and incidents

TS4

1. Are existing accident causation models and accident investigation methods able to respond to the new trends of work and working environment?

Panagiota Katsakiori, Eva Sgourou, Ioanna Papaioannou – University of Patras, Greece

The purpose of this paper is to reflect on accident causation (modelling and investigation) taking into account the new trends of work and working environment.

Changes occurring in work are the result of globalization and include changes in labour relations, in workforce demographics and the emergence of new risks. In addition to that, all the above mentioned changes take place in a wider working environment which is also changing with the introduction of complex modern equipment and safety automation and flexibility in production followed by changes in working patterns.

Accident causation models and accident investigation methods have been developed and described in the literature but the question is if there is a special need today to find both new theories and tools to incorporate the new trends or if there is a need to find either theories or tools.

The evolution of accident causation models over time shows a shift from the sequence of events to the representation of the whole system. Accident causation models can be classified into sequential, human information processing and systemic. Systemic models refer to dynamic socio-technical systems and therefore are able to adapt to the new trends of work and working environment. On the other hand, accident investigation methods are the practical tools, designed with the purpose of helping a specific user to accomplish a specific task in a specific setting. Given the fact that the specific task and setting is changing, it is time for accident investigation methods to introduce new subtools including the new trends of work and working environment.

TS4

2. Using more learning potential when learning from incidents

Linda Drupsteen – The Netherlands Organization for Applied Scientific Research (TNO), Jop Groeneweg – TNO and Leiden University, Gerard Zwetsloot – TNO and Nottingham University, Norway

Most organisations collect and analyse information about errors, incidents and adverse events with the aim to understand what happened, what caused the occurrence of these events and to learn lessons from them. Through learning from incidents, re-occurrence of (similar) events could be prevented, which should lead to meaningful improvements in safety and health performance. However, many organisations fail to learn effectively. Our research aims to better understand the actual learning from incidents processes, and to identify possible improvements in the way organisations learn. This presentation will also describe some differences between sectors such as construction and chemical industry.

We see the "learning from incidents processes" as a set of processes from reporting an incident to verifying the effectiveness of the measures taken. Building on theories of organisational learning, an analytical framework and a survey have been developed to analyse where in this process most learning potential is lost. The analytical framework consists of eleven steps, divided into four phases: investigation and analysis (including also the collection of reports on adverse events), planning of interventions, intervening and evaluating. The framework clarifies that each phase and each step can be a limiting factor.

Results from the survey based on this framework, confirm that many steps are often performed substandard, resulting in a dramatic loss of learning potential. They also show differences between the formal organisation of the learning processes and how the process is performed in daily practice. In this way the loss of learning potential can be explained and understood. In itself this is only the first step towards more effective learning. Other relevant factors and processes will be discussed, such as the "learning to learn" process (increasing the organisations capacity for organisational learning), sharing of lessons learned and contextual factors such as the organisational culture and safety culture.

TS4

3. Formal systems and arenas for learning from incidents at a Scandinavian refinery

Kirsti Russell Vastveit, Ove Njå – University of Stavanger, Norway

In light of a number of severe accidents at refineries, the potential for great harm to individuals and the environment that accidents such facilities represent and the importance accorded to incidents and near misses as indicators of potential future accidents, learning from these is considered to be of critical importance in the refining industry. Learning and experience transfer from one's own and others' incidents, near misses and accidents is however not a straight forward process, and it is usually one that can be improved upon.

As part of a project aimed at improving learning from incidents, near misses and accidents in the process industries, this article examines the formal systems that are used at a Scandinavian refinery and by a particular refinery owner to learn from incidents. Based on an analysis of documents and observations from fieldwork at the refinery in question this article describes how learning is approached by the refinery owner and refinery organization. It examines the formal tools and structures that are used in relation to learning from incidents; their procedures and assumptions, the connections between them, and the forums in which they are used. We address how learning is conceptualized and how the expectations of the various activities are expressed in terms of learning performance. The outlined formal approach to learning is then compared to normative models which describe how learning processes related to incidents, near misses and accidents should be undertaken, and uses these models to suggest what a future study of how the refinery organization actually learns from incidents should focus on.

TS4

4. Operational managers build safety by creating favourable environmental conditions for safety work

Ragnar Rosness, Ulla Forseth, Irene Wærø – SINTEF Technology and Society, Norway

The idea that "compliance to rules ensures safety" is listed as a myth on safety in the invitation to WOS 2012. The purpose of this paper is to promote the complementary myth that "operational managers build safety by creating favourable environmental conditions for safety work". By a "myth" we understand a story that expresses a partial truth about a phenomenon.

"Environmental conditions for safety work" refers to conditions that influence the opportunities an organization, organizational unit, group, or individual have to control the risk of major accidents and work environment risk. We shall elaborate the idea that operational managers build safety by creating favourable environmental conditions by discussing two examples from the petroleum industry:

Example 1 illustrates what operative managers in the Norwegian petroleum industry do to prevent excessive stress and time pressure related to downtime in drilling operations. The example illustrates how operative managers ensure favourable environmental conditions for workers in the sharp end.

Example 2 shows how a failure to create favourable conditions for safety work contributed to the explosion at BP's Texas City refinery in 2005.

Examples 1 is based on qualitative interviews, whereas example 2 is based on a literature review.

We conclude that operative managers in the Norwegian petroleum industry build safety by creating favourable environmental conditions for safety work. Further research is needed to determine to what extent this finding can be generalised to other industries and other national cultures. A failure of senior management to provide adequate environmental conditions for the safety work of operative managers may indirectly contribute to accidents. Safety is not ensured by a single means, such as compliance to rules. The creation of favourable environmental conditions for safety work is an essential part of a more complex account of safety.

TS4

5. Decline in risk perception when using chemicals as tools: suggestions for laboratory safety

Toshiyuki Tachikake, Hideki Momose, Kengo Tomita, Ikuya Shibata, Hitoshi Yamamoto, Shinnosuke Usui – Osaka University, Japan

In this study, we collected and analyzed reports of accidents over a four-year period at a Japanese university. Focusing on accidents resulting from contact with chemical substances among accidents in academic research, which accounts for 55.3% of reported accidents, we found that accident victims were more likely to be in biology, physics, or other non-chemistry fields relative to chemistry-related fields, and that the number of accident reports tended to increase among those with more research experience. In addition, of the accidents involving the handling of chemical substances, 58.2% of the

total cases resulting in accidents did not involve research in which the chemical substances were the actual subject of the research. Rather, chemical substances were used as tools in the experiment process. These results show that todays advanced research is closely related to the use of chemical substances as tools, underscoring a need for the understanding of the hazardous properties of chemical substances through basic education about chemical substances and ongoing accident prevention efforts in academic research. The use of chemical substances as tools in experimental research was found to be closely related to a decline in risk perception, and investigation of this mechanism should contribute to future safety education efforts.

TS4

6. Human error analysis of occupational accidents in the Netherlands 2005-2009

Martijn Mud – RPS, Joy Oh – Ministry of Social Affairs and Employment, Henkjan Manuel – RIVM, Linda J. Bellamy – White Queen BV, Martin Damen – RIGO Research & Advies, The Netherlands

In the Netherlands, severe occupational accidents are reported to and investigated by the Dutch labour inspectorate. Based on the resulting investigation reports, including witness statements, a root cause analysis has been performed using the Storybuilder method. Task failures and related management factors have been identified. For the period 2005 until 2009, additional detailed human error analysis has been applied on approximately 9000 accidents.

The human error analysis as performed focuses on the so-called "use-failure" of safety functions (barriers). These refer to failures where the correct barriers are provided by the organisations, but the way in which the provided barrier is used by the individual user(s) is incorrect, it is only partially used, or it is not used at all. Each "use-failure" is then further classified into (situational, exceptional or routine) violations, (knowledge or rule based) mistakes, attentional slips or (memory) lapses.

As each analysed human error is connected to a specific (technical) safety function, different combinations of these occur. Patterns can be recognised and archetypes of human errors can be identified. The statistics resulting from the analyses is based on such an extended and detailed source of accident data, that quantitative risk calculations can be performed to estimate the maximum effect of different behavioural risk reduction strategies.

Parallel session TS5: Risk analysis methods and tools

TS5

1. Risk assessment methodology to support shutdown plant decision

Eduardo Calixto – Federal University of Rio de Janeiro, Carlos Daniel, Cid Atusi – Petrobras, Brazil

Nowadays one of the most important decisions in safety issues in Brazilian Oil and Gas industry is when it's necessary to shutdown plant because one specific failure or required maintenance in protection system and that take influence in risk level. Most of time, experience operators decide based in their background despite carrying out a risk analysis to support their decision. Therefore in so many cases, refinery plants works in catastrophic risk level due to subjective decision. In order to improve the operator decision, a specific methodology was established to apply risk assessment using PRA (Preliminary Risk Analysis), LOPA (Layer of Protection Analysis) and FTA (Fault Tree Analysis) in order to check risk level or layer of protection availability. By this way, as first step, the Preliminary Risk Analysis will be carried out in order to qualify risk and mainly define consequences severity. The second step will be carry out the LOPA in order to find out the failure probability of all layers of protection. In addition, when is necessary to check contingency systems availability FTA will be carried out. On first cases, that is possible to substitute the layer of protection for other one in order to keep risk in acceptable level. On second case is necessary to check if contingency system is available and assess if consequence get worse or keep on same level. On both cases, the final risk will be assessed and compared with the previous one defined on PRA. In case of risk is unacceptable the final decision will be shutdown plant. The refinery case study case will be show as instance of such methodology.

TS5

2. A Semantic Web approach towards Safety Knowledge Management

Lars Aprin – University of Wuppertal, Germany

Risk analysis is an essential part of continually improving operational safety. This paper concerns the adaptation of current IT innovations, in particular Semantic Web methods, to optimize the base data for risk analysis.

The completion of a risk analysis is tied in many ways to access to knowledge sources. There have to be standards for aggregating knowledge, especially about incident histories,

current work processes, the work environment, and possible preventative measures. Getting reliable and adequate results from risk analysis depends on the availability and quality of information offered by an organization. In day-to-day operations, however, the flow of information is not rarely constrained by various hindrances. Information of decisive importance to a risk manager lies hidden in data silos which are difficult to access, is extracted only with a significant amount of time from scattered reports, or will be simply overlooked in the face of the increasing flood of information.

With this background, the University of Wuppertal and the European Organization for Nuclear Research (CERN) are working together to apply Semantic Web technologies already used in many fields to find solutions to the problems facing risk analysis. At the core of this project is the idea that knowledge relevant to risk analysis, such as work-related accidents, should be documented in the form of an ontology. Ontologies allow knowledge of one domain to be organized in such a way that linguistic ambiguities are reduced, scattered data silos are integrated, and automatic processing of information becomes possible. The risk analysis ontology functions as a knowledge base for a search engine which allows risk managers to enter details of current working processes, call up the accident histories of similar work processes in the past, and to propose suitable prevention measures.

TS5

3. Paradigms and safety requirements for new generation of workplace equipment

Tadeusz Missala – Industrial Research Institute for Automation and Measurements (PIAP), Poland

Workplace in the manufacturing industry, as it to define broadly, contains not only stationary equipment (e.g. machine tools, workmanship centers, fixed robots) but also mobile equipment (e.g. AGV, mobile robots). In addition mobile equipment as well as fixed industrial robots cooperates directly with the people (workplace staff, servicers, programmers). Workplace equipment shall not only be safe for the people, but also don't generate the feelings of fear or strangeness, better if can generate the feelings of peace and confidence.

In such a situation, when the uncomfortable feelings are, in general, caused by industrial and mobile robots, the laws of robotics formulated by Asimov aren't sufficient. The new law of robotics' robot is a human friend, and the paradigms' workplace equipment must be friend to humane, is necessary to be formulated.

In light of his law the chosen examples of robot-human cooperation will be presented, the safety requirements and safety functions elaborated till now will be reviewed, a package of chosen new safety functions, necessary to fulfill the above mentioned paradigm, will be pointed, as well as proposals works to make the workplace as an environment friend to the human will be presented. The examples of these works, realized and in development will be mentioned.

TS5

4. What are the work places that will have increasing accident risks in the future? Delphi-study in Finland

Jorma Lappalainen, Susanna Mattila, Markku Aaltonen – Finnish Institute of Occupational Health (FIOH), Finland

The goal of the study was to explore new information to support the forward looking planning of accident prevention by labour protection inspection in years 2012-2015. By using Delphi-method with three phases we investigated what risk groups and accident hazards can be important in the future of the Finnish working life. We defined that those, whose importance is growing or, which has now only some weak symptoms.

We invited in the project a panel of Finnish experts of occupational accidents. They were from industrial companies, labour inspection, insurance companies and research institutions. The inquires of the project was done with Digium program via Internet.

The main findings of the project. The probable factors increasing accident risk in Finnish work life will be following: a increasing number of foreign workers, a increasing number of turnover of personnel, hired work force, economical crises, changes of organisations, outsourcing, a underrating the importance of traditional health and safety and new technology. The problems in the management of subcontracting chains will increase occupational accident risks at least in manufacturing industry, in construction and in energy sector. Maintenance is a work task whose accident risk will increase in the manufacturing industry, in the service and energy sectors.

TS5

5. An integrated tool for ergonomic risk assessment

Gyula Szabó, Martina Dobo – Óbuda University, Hungary

Despite decades of efforts the rate of work-related musculo-skeletal disorders (WMSD) is still very high. In case of WMSD the solution should be prevention that requires both safe machinery/equipment design and risk management at the workplace. To identify WRMS

risk factors a wide range of ergonomic methods are available internationally, starting with simple check lists for hazard identification through paper and pencil based or spreadsheet implemented software for screening or for risk assessment ending with the now maturing computer technology with motion capture based imaging techniques. Although various collections exist that contain hundreds of ergonomic risk assessment tools very few of these are generally accepted and widely applied. The difficulty in particular is that a "universal tool" cannot be chosen because each method is valid for different situations some are for special activities others for distinct body parts, therefore selecting the appropriate method is an additional issue.

In Hungary the situation is severe because of the high rate of ergonomic risk affected jobs including manual material handling and repetitive movements. Although in conjunction with the EU regulations the risk management at workplaces is obligatory but there are still no methods available in native Hungarian that health and safety professionals can use.

An Óbuda University R&D project aims the development of a complex Ergonomics Risk Assessment methodology based on the EN 1005 standard series that allows the composite ergonomic risk assessment of workplaces regarding position, force, manual handling and repetitive motion. The newly invented methodology CERA is for occupational safety and health practitioners with basic knowledge to apply its several versions according to application conditions. For basic evaluation a paper and pencil method and for more detailed analysis a spreadsheet is provided in which all assessments of the EN 1005 standard series are included.

TS5

6. The methods of virtual modelling of dangerous zones and safety devices to support risk assessment in machinery design

Marek Dźwiarek, Jarosław Jankowski – Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Poland

The research part of which is presented hereinafter aimed at the development of dangerous zone virtual modelling technique in the aspect of supporting safety system choice as early as at the design stage of machinery and manufacturing systems. To achieve that, the principles for the identification and modelling of dangerous zones, their access zones and safety devices (guards, electro-sensitive protective devices and pressure-sensitive devices), respectively, were formulated. A general application procedure has been developed as well, to show how the virtual modelling should be employed to choose properly a safety system in machinery and manufacturing systems. The methods have been developed to integrate the dangerous zone modelling system with the system of

interactive communication with the user in virtual reality. The developed methods were verified using a virtual model of a manufacturing system, comprising two robot groups and a workstation located between them. A virtual model of a sample machine was used as well.

Keywords: Safety of machinery, virtual reality, CAD

Parallel session TS6: Information, communication and standards

TS6

1. EUROSHNET – Sharing knowledge and experience for high-quality standards and innovation

Rüdiger Reitz – German Social Accident Insurance (DGUV), Germany; Dariusz Pleban – Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Poland; Pirjo-Irmeli Korhonen – Finnish Institute of Occupational Health (FIOH), Finland

EUROSHNET (www.euroshnet.eu) is a network for cooperation between European OSH professionals active in standardization, testing, certification, and/or related research. EUROSHNET wants to provide novel approaches and a global view of product safety and all its aspects, with a particular focus on networking.

Numerous stakeholders are involved in the regulation, testing, certification and standardization of occupational safety and health (OSH) in Europe. It is clear that only active interaction and communication between stakeholders can ensure the safety of products used in European workplaces. The 4th EUROSHNET Conference, which will take place in June 2012, focuses on means to improve interaction and communication between those stakeholders. The aim of the conference is to promote an integrated approach to the various, and sometimes contradictory, aspects of occupational risk prevention in Europe.

Besides its successful conferences, EUROSHNET offers an Internet platform for OSH experts to share and discuss experience from the field, gaps detected in individual standards, new technologies, advanced products or the need for further research. By collecting such input and presenting it to the standardization process, the experts registered with EUROSHNET support the development of high-quality standards, innovation and competitiveness, which in turn lead to safe products and an improvement of safety and health at the workplace.

EUROSHNET is supported by a Steering Committee and a Working Group with members of OSH institutions from Finland, France, Germany, Poland and Spain. Over 500 experts from 20 European countries are registered with the network.

The paper will focus on EUROSHNET's role as an intermediary between practical life in occupational settings and standardization and provide some general information on the functioning of the network.

TS6

2. Information and communication activities towards safety improvement

Agnieszka Młodzka-Stybel – Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Poland

Current technological, economic and social changes, related to the development of an information society, influence contemporary working and living conditions. In the area of occupational safety, new and emerging hazards specific for this period are being recognized, as are new possibilities of improving working conditions, supported by ICT technologies. In the increasingly complex working environment, the role of professional information and communication in creating safe conditions is greatly appreciated. Information activities, supported by modern ICT tools, cover all the processes of knowledge organization and management in the area of safety: from gathering simple or complex information to its transfer to target users. This paper presents new possibilities of improving safety which related to the development and maintenance of professional databases, the increasingly popular use of social media for exchanging knowledge and experience, networking as well as modern Internet tools supporting OSH oriented activities.

The new directions, connected with the use of ICT, are strongly recognized by international bodies and introduced into long-term planning procedures and strategies, aimed at improving occupational safety. Too many accidents at work still take place because of poor knowledge and lack of safety awareness. So, an approach that stresses the issues of informing and communicating, exchanging information and providing access to modern sources of digital information fully reflects contemporary trends. However, the real effectiveness of safety improvement strategies based on ICT depends on the level of information society development, which varies strongly among countries as well as the enterprises of various size.

TS6

3. Safety marks for work equipment. Benefits for manufacturers, purchasers and OHS

Rüdiger Reitz – German Social Accident Insurance (DGUV), Germany

Safety marks have proved to be an important element in product safety. Examples are the GS mark and the EuroTest mark. Both of these marks are awarded by independent testing and certification bodies if a product satisfies all of the defined safety and health requirements. A product that holds the safety mark can win buyers' confidence.

From a manufacturer's perspective, the benefits of testing and certification begin long before the actual awarding of the safety mark: during the testing process, the independent body disclose any safety defects the product may have. The manufacturer eliminates these defects before a safety mark can be issued. Therefore safety marks can be used as a marketing tool. The benefits for manufacturers so go way beyond the confirmation of legal compliance.

Commercial buyers have to assess the safety of the work equipment. However, certain attributes only become apparent when the products are being used, or the buyer cannot determine these with reasonable effort (so called experience respectively credence attributes). This is where safety marks can provide guidance in the selection process: they indicate that the product has successfully passed the test and this therefore creates trust.

For safe and healthy workplaces, safe work equipment is an absolute must. Influencing equipment right at the source of their production therefore has a positive effect on safety at the workplace. As well as the direct consequences of testing and certification, the indirect consequences also play an important role: the general findings of testing and certification can provide useful input for further prevention measures, as e.g. standardisation work and R&D. For all this to be successful, however, the test requirements must be based on a prevention-orientated risk assessment.

On the basis of case studies and quantitative indicators the presentation will point out the benefits of safety marks.

TS6

4. Customized safety and health channel by desktop AP tool

Yi-Chun Yu, Yun-Chin Lin – Institute of Occupational Safety and Health, Taiwan

To provide personal of various occupational safety and health information for each one respectively, a personal computer based web tools as "Desktop AP" was set up and downloaded for personal subscription. The "Nanny OFFICE desktop Application" is under the Acrobat circumstances and provides all all information that based on the knowledge-based OSH research Institution. The database of research reports, animations, news, films on Youtube, and RSS feedings are the basic structure on the users' end. The national wide safety and health awareness campaigns and exhibitions in the national science and technology museums were associated to these services. News about the industrial accidents and alerts for the employer and employee to prevent hazardous and/or dangerous occurrences are the most attractive ways to keep the subscribers actively listen and then consult specific technical information by themselves. To enhance the utilizations,

the targeted audiences were set as the heavy internet dependent white collar, especially office lady. A health promotion and diet control program was attached to keep the records of daily calories uptakes and exercises. Five "Electronics books" on a shelf were provided free to download and read. Multimedia materials, some flash films and also user-friendly risk assessment software and tools were collected and embedded into an electronic book. One of them was rated the "Runner-up Award" at the 8th International Multimedia and Film Festival during the XIX World Congress on Safety and Health at Work, 2011. This active and dynamic informational channel instead of passive internet roaming was prove promising and to bridge the next stage social media. The new templates for specific topic in OSH curation by self-proliferation will be available to plate computer or intelligence cellular phone to carrier and rooted to everybody's daily life to fulfill the demands of Human Rights of Economics, Social and Culture Covenant.

TS6

5. Safety of nanomaterials supported by standardization

Delfina Ramos – Polytechnic Institute of Cávado and Ave, Luis Almeida – University of Minho, Portugal

The ability to understand and control matter at the nanoscale is leading to a "revolution" in technology and industry. The rapid development of nanotechnology has led to the emergence on the market of several products containing nanomaterials (nanoparticles, nanofibres and nanoplates). Knowledge of the exposure to, or effects of, engineered nanomaterials on human health and safety in occupational environments is limited and does not allow reliable assessment of risks of these materials on workers' health. Also negative impacts on the environment are often not yet known.

The European Commission has set out a European Strategy for Nanotechnologies, based on a "safe, integrated and responsible approach". An important instrument of this strategy is standardization. Standardization is considered as essential to make a certain regulation in the market and avoid future problems. The European Commission has recently issued a second mandate to the three European Standardization bodies (CEN, CENELEC and ETSI) asking to develop standards for testing methods and tools for the characterization, behaviour and exposure assessment, which is being handled by the Technical Committee CEN/TC352 – Nanotechnologies.

In this paper an overview of the present situation and foreseeable evolution of the standardization related to Nanotechnologies is presented, with emphasis on the situation at European level.

The European Integration and Innovation Platform "Nanofutures" has also recently identified, after a survey made with more than 50 European Technology Platforms, the importance of Standardization in promoting Safety and Sustainability of Nanotechnologies. Standardization can be an important tool to the so-called "nano-responsible development", including integration of risk and benefit assessment in the production, marketing and use of nanotechnologies, nanomaterials and/or products incorporating nanomaterials.

TS6

6. Social Responsibility and OSH in the context of Romanian national SR strategy and the publication of ISO 26000 Guidelines for social responsibility

Steluta Nisipeanu, Maria Haiducu, Ruxandra Chiurtu – National Research and Development Institute on Occupational Safety "Alexandru Darabont" (INCDPM), Raluca Stepa – Kooperationsstelle Hamburg IFE GmbH, Romania

As an inspiring and strategically important development, social responsibility (SR) is becoming an increasingly important priority for companies of all sizes and types. Occupational safety and health (OSH) is an essential component of SR and this presents managers and OSH professionals with a variety of opportunities and challenges. With increasing globalization, greater environmental and social awareness and more efficient communication, the concept of companies responsibilities beyond the purely legal obligations or profit-related objectives has gained new impetus. Businesses need to seen acting be responsibly towards people, planet and profit. The paper presents the actions taken by Romanian companies in the medical sector to define their social responsibility performance.

Parallel session TS7: Advanced PPE solutions

TS7

1. Personal protection equipment for contracted maintenance works at major industrial sites: A tool for sharing knowledge and supporting decisions

Paolo Bragatto, Silvia Ansaldi, Patrizia Agnello – Italian Workers' Compensation Authority (INAIL), Italy

The PPE management for contracted works has been investigated at a large industrial park, where a few major companies operate the plants and contract out all maintenance works to many small maintenance firms. The deficiencies in instruction and guidance, the cultural and physical isolation are frequent causes of accident in contracted works. A way to involve third party workers in the safety culture is to share safety decisions, including the choice of PPE. For any maintenance work, the appropriate PPE must be selected, taking into account both the task related risks and the risks posed by the industrial environment, including the loss of hazardous materials, with consequent fires, explosions, toxic clouds.

The safety knowledge is fragmented between plant operators and contractors and just by sharing expertise it is possible to consider all potential interferences. The cooperation is essential and different experience and information on risks and related PPE must be merged. To achieve this goal a methodology and a software tool have been developed, to support operators and contractors in the PPE decision making.

The core of the method is a knowledge-base, which organizes information about maintenance works, occupational and accidental risks and protective equipment. "Ontologies" have been used, because they allow the organization of topics and the construction of multiple relationships between different classes, from which decisions can be inferred. By means of the developed software, operators and contractors have merged experience and information and have prepared permits to work with appropriate PPE. Practical knowledge about safety, hidden in the minds of many different operators and contractors, has been pooled and connected.

The method is suitable for all process industries where maintenance is usually contracted. The strength of the method is that plant operators and maintenance personnel are forced to share knowledge and work together for safety.

TS7

2. Advanced PPE system ensuring active protection during rescue activities – i-Protect project approach

Piotr Pietrowski, Daniel Podgórski – Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Poland; Jesús M. López de Ipiña – TECNALIA Research and Innovation, Spain

Nowadays, Personal Protective Equipment (PPE), is a crucial part of the safety provisions especially during the rescue activities carried out by fire-fighters, chemical rescuers as well as mine rescuers. The general requirement for the PPE is to protect the users from various risks. In case of rescue activities the risk is very complex and rescuers could be exposed to high temperature, fire, toxic liquids and gasses, dusts, fume and limited access to breathable air. Moreover, rescue activities are usually carried out in confined spaces with poor visibility where lack of communication between the rescuers themselves as well as with the command centre may occur.

The goal of i-Protect project is to develop and demonstrate prototypes of the new multifunctional PPE which creates a system addressed the needs of chemical rescue teams, firefighters and mine rescuers. The core of the development is integration of microsensors, with protective clothing, aimed at real-time monitoring of defined risk factors (temperature, various gasses) and integration of optical fibres with material of underwear for monitoring users' health status (body temperature, heart and respiratory rate). The PPE system will assure efficient wireless communication between the rescuers and Rescue Coordination Centre (RCC) – also to be developed within the project. The data transmitted from each sensory module to the RCC will be stored and visualized in order to support decisions of the rescue Commander.

All the safety and quality parameters of the PPE system will be tested and verified by end-users in laboratory conditions simulating real working environment and in field test. Special attention will be paid to checking effectiveness and reliability of integration of individual system modules against the user's safety, comfort of use, accessibility of individual system elements, as well as legibility and quality of data transmission.

TS7

3. Innovative strategy for bridging research into personal protective equipment industries by a model of venture capital

Yi-Chun Yu – Institute of Occupational Safety and Health, Taiwan

The research outcomes from an occupational safety and health research institute should serve to fulfill the needs of employer and employee, and the best way will be to

stimulate the industries for safety and health products and best practices consultation services. However, the benefits of prevention accidents in the business value chain could replace the cost as more than 4% GDP. The Innovation Initiative in Europe mentioned the scope of supporting for innovation, innovation unlimited, and innovation policy. Questions were raised that the business of safety and health should be constructed and ready for any one to use in a country. To compile these basic concepts into Taiwan infrastructure for development, the originally expertise-base institution for preventing occupational injuries and illness transfer his missions to assist the technology flow and outreach. The following action plan were set up: A designated agency was established to facilitate the bridge the gap of enterprises' needs; Intellectual property rights management including patentable technology, technology transfer and spill over under the instinctive avoiding conflicts of interest; Enterprises and research institute cooperation scheme such as "call for proposals" and the selected subsidiary project from Ministry of Economics; "Entrepreneurs Incubator" is located at the facility; Trade show across the world and negotiation of investments will were assisted by the research fellow. The successful and fruitful OSH related enterprises in Taiwan are: Active Radio-Frequency Identification techniques attached with sensors are cooperated into Personal Protective Equipments, personnel management in confine space construction project, protect from falling into sea in the fishery industry; Push-pull ventilation systems and active noise cancellation systems; and also the consultation services for occupational hygiene, ergonomics and energy saving are some good model to approach green industry. The cost-efficiency analysis showed a joint venture model close to the national research institute can lead to excellent OSH industries.

TS7

4. Training systems and the remote monitoring system supporting correct use of earmuffs

Dariusz Pleban, Leszek Morzyński, Paweł Górski – Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Poland

Research works carried out in the conditions of use of hearing protectors show, that the real exposure to noise of workers using hearing protectors may be higher than it results from theoretical calculations and, in some cases, it may exceed exposure limit values. The reason for this discrepancies is mainly incorrect use of hearing protectors resulting from the lack of knowledge and training of workers.

Therefore it is necessary to develop new technical solutions which will support learning of proper use of hearing protectors and allow better supervision of its use. In CIOP-PIB research on this type of solutions is carried out.

One of currently developed solutions is an interactive system for training of the correct use of hearing protectors. This system consists of appropriately constructed hearing protectors that interact with computer system and thus allows for systematic assessment of the trained person. The system will include also a guide and a set of training films.

A system for remote monitoring the correct use of ear muffs will give even greater possibilities of detection of deficiencies in their use. The system will include three essential elements: the electronic systems for recording the parameters of noise under the cups, a monitoring station (for collecting and processing the data sent from the systems for recording) and a wireless network for data transmission. The system will monitor and record noise parameters under the cups of ear muffs and will transmit the data on noise exposure to the central unit of the system as well as notify the supervisor of the system and competent employee in the event of excessive exposure to noise.

TS7

5. Influence of preloading on parameters of connecting and shock-absorbing components of personal equipment protecting against falls from a height

Marcin Jachowicz, Krzysztof Baszczyński – Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Poland

A fall from a height is one of the most serious hazards encountered by workers at their worksites. Personal equipment protecting against falls from a height is still one of the basic methods of ensuring safety under such conditions. To function properly, such equipment must be monitored for technical condition. Loads, associated e.g. with fall arrest, exert the most significant influence on changes occurring in the equipment. Such changes may result in marked deterioration of protective parameters, being at the same time imperceptible for the user. The paper presents the results of a study investigating changes in personal equipment protecting against falls from a height, containing textile elements, while bearing loads under static and dynamic conditions. The tests were based on methodology specially developed for this purpose. The tested objects included textile ropes and webbing, sewn joints typical of full body harnesses, as well as complete components, i.e. lanyards and textile shock absorbers. The presented test results provide a basis for designing functionality detectors for equipment protecting against falls from a height; the preliminary concept of such detectors, installed in various components

of protective equipment, has been presented. Their task is to inform the user abort the loss of protective properties due to exceeding the critical load. They make it possible to reduce the risk associated with use of inefficient equipment protecting against falls from a height.

TS7

6. Reducing the dust of asbestos fibre

Bruno Bisson – ISSA Construction Section, France

Being in charge of prevention and operator of tracking asbestos, Didier LACOUR found the solution to reduce dust during asbestos removal operation in confined areas. The asbestos removal operators, equipped with dry suit, work in sweltering heat with health risk related to asbestos fibres in the air.

His idea is inspired by the micro diffusion dryer used in hospitals to transpose it at the asbestos removal sites. His project will be in development for two years before the final commercialisation of the concept CLEANDUST®.

Consisting of a compressor (out of area) and a rotating diffuser nozzle, the machine is very easy to use. Decontaminated with water, the portion inserted into the enclosed area will act as one giant sprayer diffusing very fine particles of water.

This dust removal system allows the cooling of the atmosphere and has proven its effectiveness since the measurements taken before diffusion and after, reveals a significant reduction of dust equal to a factor of 10.

The area benefits from a total humidification without the usual discomfort associated with the intermittent use of water in which employees paddle and which can sometimes cause damage. The process CLEANDUST® can cover an area of diffusion up to 5.000 m^3.

Results: The asbestos removal companies using CLEANDUST® express their real satisfaction, both in reducing the dust and in improving employees comfort.

Advantage of the material: The process is not limited to solely asbestos removal sites and can be used in any other areas of activities which generate dust, particularly sites of lead paint removal and interior demolition.

Parallel session TS8: Safety regulations and inspection

TS8

1. Safety regulation: the lessons of workplace rule management for managing the regulatory burden

Andrew Hale – Health and Safety Technology and Management Ltd (HASTAM), UK; David Borys – Victorian Institute of Occupational Safety and Health, Ballarat University, Australia; Mark Adams – George Mason University, USA

There is a strong political consensus in a number of countries that occupational safety and health regulation is stifling industrial innovation and development and is feeding a culture of damaging risk aversion and petty bureaucracy. In a number of countries this has led to proposals to repeal regulations and reduce the regulatory burden. The authors were commissioned to prepare a discussion paper on this issue by the Mercatus Center of George Mason University in Arlington, Virginia, aimed particularly at an American audience.

The paper is based on previous work of the first two authors, developing a framework of safety rule management at the workplace level (Hale & Borys 2012a and b). Based on a literature study, this paper analyses the similarities and differences between rules at the workplace level and the development, use and enforcement of regulations at the national level to influence and control organisational behaviour. It traces the forces encouraging the growth of regulatory detail and hence the bureaucratic burden of compliance and the options open to reduce that burden without loosening control so much that the level of safety declines. The analysis uses the hierarchy of rules from goals, through process (risk management) rules to detailed action rules as framework for predicting the level of ownership and responsibility felt by the regulated.

TS8

2. Effects of the Occupational Safety and Health Enforcement Act on the workplace safety activities

Hanna Uusitalo, Riikka Ruotsala – Finnish Institute of Occupational Health (FIOH), Toivo Niskanen – Ministry of Social Affairs and Health, Finland

This investigation examined workplace views on official enforcement, and co-operation on occupational safety and health at workplaces. The research data was collected by

a questionnaire and by interviews in 2011. The respondents and the interviewees were mainly representatives of the employer and representatives of occupational safety and health bodies.

The workplaces made a positive assessment of the enforcement by authorities and its effects on workplace safety and health. The inspection had lead to corrections of shortcomings noticed at workplaces. In addition, access to information was seen as important. Furthermore, the inspection had lead to creation of documents related to occupational safety and making those documents more accurate as well as to more systematic development of occupational safety and health at workplaces. The perspective of effectiveness in mind, it is hoped in workplaces that the inspections would be oriented more towards the direction of co-operation and guidance.

The obligations had been met very well at the workplaces. From the respondents' perspective, it is not of fundamental importance which of the obligations "written advice or improvement notice" is placed on them since all the matters has to be put in order. The workplaces regarded the monitoring of the adherence to the obligations as an effective way of enforcement.

The respondents evaluated the co-operation as successful and functional, even though the data also produced concerns about the commitment of the management, and of the staff as a whole, to safe operations and promotion of workplace safety and health.

As the co-operation in occupational safety and health varies from one workplace to another, the question of effectiveness is concerned with how the enforcement could intervene to the problems so that co-operation at workplaces would function well to solve the problems.

TS8

3. The implementation of safety-related legislation: applied models and practices

Juha Vasara – Tampere University of Technology, Finland

Smooth drafting, introduction, implementation and enforcement, and the right influence are the objectives of those drafting new legislation and the authorities responsible for the implementation and enforcement of the legislation. The legislation sets requirements for both companies and authorities. Successful implementation of new legislation may be difficult for the authorities as well as for the targets of implementation, i.e. the companies. However, the process of implementation should already be envisaged when the legislation

is drafted. This paper discusses the results of a literature review focusing on the execution of the implementation process. The specific interest was the implementation of legislation, especially safety-related legislation, from the authority's perspective. The implementation is traditionally approached using two perspectives "top-down" and "bottom-up" and their combinations. According to the top-down perspective, decision-making is considered, for example as the authorities' task. The implementation begins from the political and/or legislative objectives and proceeds linearly. According to the bottom-up perspective, the lower-level officials as well as the companies should be able to participate in the decision-making process. From the business point of view, the safety legislation may not be considered as the most relevant legislation, and special actions may be required for the authorities to get certain companies to comply with the requirements. It is argued that compliance with the requirements is most likely when an appropriate law exists, when it is effectively communicated and the authority has expressed an explicit model of the different levels of enforcement. From the regulator's and authority's perspective, for example a so-called enforcement pyramid is recommended as a model of a functioning implementation process.

TS8

4. Greek national policy on occupational safety and health: new and emerging challenges

Ioanna Papaioannou, Panagiota Katsakiori, Eva Sgourou, Stavros Goutsos – University of Patras, Greece

The purpose of this paper is to present an overview of the current situation regarding the Greek national policy on occupational safety and health (OSH), within the framework of the general national labour policy, and to identify all the challenges which are currently posed to it in terms of OSH regulation and enforcement.

The Greek national policy on occupational safety and health has been especially affected by the country's economic crisis since the latter has brought in a significant "structural" change in the world of work. On the one hand, the changes which have taken place concern the form of labour relations drifting away from the traditional model of "secure" fulltime permanent employment to "flexible" forms of unstructured labour patterns, such as temporary employment and cyclical work, and an enormous increase in job insecurity. On the other hand, changes are associated with the lack of available resources, which is crash-testing the institutional capacity to support the implementation of OSH strategic objectives (i.e. strengthening the labour inspection system) as well as resulting in the prioritisation of financial objectives (i.e. ensuring compliance regarding contributions to the social security organisation).

In this framework, several implications arise for the effectiveness of the legislative framework and its enforcement mechanisms as well as the approach towards the general public in terms of promotional and enforcement strategies. Additional challenges posed relate to new and emerging occupational risks (i.e. risks associated with psychosocial factors at work).

TS8

5. Dealing with double standards. Maritime regulators' handling of political paralysis

Kristine Vedal Størkersen – Norwegian University of Science and Technology (NTNU Social Research), Norway

Many maritime transport branches are very exposed to accidents. Although safety on the ships along the Norwegian coast is primarily the responsibility of the ship owners, two national regulators facilitate and control maritime safety: The Coastal Administration and the Maritime Authority. This means that maritime safety to a large degree depends on decisions and interaction between regulatory levels, and the organizations. Lindøe et al. (2011) have shown that interaction that can prevent accidents is difficult in the maritime arena; this is due to the international structure of the sector combined with lack of public interest and consequently pressure groups. The industry experiences that even regular occurring deaths do not lead to structural changes (Lindøe et al. 2011:95).

Before one can find solutions to this situation, it is necessary to know more about *what affects Norwegian maritime regulators' decision-making, and how do they handle the situation when promoting safety in the maritime transport arena?* Interviews with representatives for the two Norwegian regulatory bodies are therefore the empirical foundation for this study.

Results from the analyses are consistent with prior research and reveal that regulators' safety decisions are affected by the conspicuous international legislation, different priorities in the ministries and the industries' financial abilities. None of the actors are able to dominate the process because the maritime transport arena has too many constraints and systems that lack flexibility. This can be understood as a political paralysis (Renn 1992) in maritime decision-making, and can lead to distress for maritime transport safety. Although being a part of this situation, the Norwegian maritime regulators do not describe themselves as incapable of action: they have mastered the art of translation between legislation and industry, face the priority dilemmas and balance both goods.

Keywords: Safety; maritime industry; regulation; regulators; decision-making; safety priorities

TS8

6. National occupational safety policy of Cyprus: impact on safety performance

Georgios Boustras, Athanasios Hadjimanolis – European University Cyprus, Cyprus

Cyprus, a small island country in South Eastern Europe, entered the European Union on May 1st 2004. From then on, its health and safety legislation is based on European Commission Directives.

Historically, a first attempt to introduce a safe environment for the labour force has been made between 1947 and 1956 by the then Colonial British Government. A complete, comprehensive health and safety law has passed in 1996. Subsequently, this legislation has been enriched and modernised until the present day. The National Strategy on Health and Safety 2007-2012, designed and agreed by both the Ministry of Labour and Social Insurance and the Trade Unions has set an aim of reducing accidents at the workplace by 25%.

This paper will discuss the present situation and will identify if and how the accession to the EU has had an impact: (a) on the adoption and development of a safety policy for the country as a whole, (b) present in measurable terms if National safety performance as an outcome of policy changes has improved or not and (c) explore the current policy implementation mechanisms in relation to health and safety.

The authors will use legislative, historical and statistical data to explore the impact of changes on safety policy and safety performance (e.g. accident rates) in Cyprus. It will also compare the findings with those of other countries.

Parallel session TS9: Safety in specific sectors: construction

TS9

1. The health and safety coordinators' potential to prevent injuries on construction sites

Lena Almén, Tore J. Larsson – School of Technology and Health, KTH Royal Institute of Technology, Sweden

The risk of occupational disease and serious injury in the building and construction industry is high. The earlier in the construction process, the greater are the possibilities to reduce hazards.

According to the Swedish legislation, Architects and Design Engineers shall, within the framework of their assignment, ensure that aspects of health and safety are considered during the construction of a building as well as in the use of the finished building.

Since the 1st of January 2009, Clients (natural or legal persons for whom projects are carried out) in Sweden are obliged to appoint a Health and Safety Coordinator for the design and planning of the building. The Coordinators must have the educational skills and experience needed to perform their duties.

The aim of this study was to find out what persons are appointed to be coordinators, how they perceive their duties and, potentially, what could facilitate the Health and Safety Coordinators' activities and construction site safety.

Telephone interviews were carried out with 40 Health and Safety Coordinators for the design and planning phase of 42 building projects during 2010.

The Coordinators education and experiences varied to a large degree. Their description of duties also varied greatly, from no duties, to administrative duties, to active injury prevention.

According to the Coordinators, the following factors had a positive influence on their possibilities to act for injury prevention:

- The Coordinator is appointed early in the process.
- The Coordinator has authority in the project.
- The Client prioritizes occupational safety.
- There is knowledge of construction methods in the design team.

TS9

2. Safety Design integrated in the Building Delivery System

Kirsten Jørgensen – Technical University of Denmark, Denmark

It is important to see safety and health in construction as an integrated part of the way in which designers, architects, constructors, engineers and others carry out their consulting services.

The purpose of this article is to demonstrate how safety and health can be integrated in the design phases of the building delivery system by using the principle of the lean construction modelling.

The method for the research was to go through the lean construction building delivery system step by step and create a normative description of what to do, when to do and how to do to fully integration of safety in each process. The group of participants who created the description had a high experience in a combination of research, safety and health in general and especial in construction and knowledge of the lean construction processes both from the clients perspective as well as from the designers and the consultants.

The result is a concept and guideline including control schemes for how to integrate safety design in the lean construction building delivery system including what to do and when. The concept has been tested in an educational context and found useful by the designers.

The practical value of the concept depends never the less on how you manage and organise the detailed design process. In the final end prioritization, motivation and leadership is of crucial important for the construction process and how good the safety at the site will be for the craftsmen. The developed concept has to be seen as a valuable and practical tool for obtaining the safe site.

TS9

3. The Bam-Bus project – a preventive service for the construction sector

Anders Kabel – Preventive Service for the Construction Sector, Denmark

The Preventive Service Bus for the Construction Sector is a mobile preventive service for dissemination of good practice to construction sites.

The labourmarket organisations in the construction sector established the Preventive Service Bus as part of their collective agreement after the repeal of the mandatory occupational health service system in Denmark in 2008.

After establishment fourther organisations have joined the Preventive Service Bus – even The Danish Association of Construction Clients (DACC).

The Preventive Service Bus is financed by the Construction Sector Development Foundation, and advice and/or visits by the Preventive Service Bus are free of charge for members of the participating organisations.
The concept of the advisory work is to focus on the specific and relevant problems and challenges in the actual building situation and to use them as cases for enhancing prevention through the cooperation between the coordinator and the construction companies at the construction site as well as the in-house planning, training, communication etc. in the construction companies.

The consultants disseminate the practice described in recommendations from the Sectoral Working Environment Council on Building and Construction and from the governmental Labour Inspection and "translate" these recommendations into the actual building situation.

The advisory work is positively received by the construction workers and the employers as the Preventive Service Bus is established by their own organisations.

The co-operation with clients, architects and engineers is increasing and many of them need help to solve the health and safety at the construction sites.

TS9

4. Improving the safety of road workers. Enough innovation?

Anita Venema – The Netherlands Organization for Applied Scientific Research (TNO), Berend Brinkhuis – Van den Berg Infrastructures, The Netherlands

In 2007 and 2008 a Dutch study showed that road construction workers suffer a higher fatal injury risk at work than general construction workers. The study was part of a larger project were all stakeholders at the national level and at company level worked together to investigate especially the crash risks of road workers, the causes of these crashes and opportunities to improve the safety of road workers.

In this presentation we would like to present some of the preventive measures that were taken after the study in a Dutch road worker company, present results of their effect and discuss the question on how to further improve road worker safety.

One of the outcomes of the study was that road workers were not always aware of their unsafe acts. An observational study recorded 20 unsafe acts for a team of road workers in one hour time. It was decided that awareness should be raised at all levels of the company and safe behavior should be promoted. A video was prepared to raise awareness in the company, road workers and managers alike. The video used actors but was based on situations actually observed in the project. Also toolbox meetings were organized around three themes supported by stickers:

Keep distance
Keep an eye
Be visible.

The campaign was evaluated using a worker survey before and after the campaign. Results will be presented.

In the chain of responsibilities, road workers are at the final, and most vulnerable end. More advanced solutions could be found in innovative barriers and in more prominent inclusion of safety aspects in the process of bidding, negotiating and planning the work. We welcome suggestions.

TS9

5. Mind the gaps: A new approach to involving principals and designers in health and safety in all phase of the construction

Adri C P Frijters – ARBOUW, Shahid I. Suddle – Delft University of Technology, The Netherlands

In the construction industry, many decisions relevant to the safety of employees in the execution phase are made by organizations whose primary involvement is restricted to the design phase. These decision makers are not responsible for the execution of the project and thus do not feel that they are responsible for safety during the production process. Research shows that about 50% of accidents are caused by decisions made in the design phase. European Directive 92/57 aims to address this issue of accountability.

The Dutch Working Conditions Act covers health and safety matters for employers and employees. This legislation provides a framework. Supplementary details in the Act – the "how to's" as it were – are included in the sector-specific Health and Safety Agreements. However, architects and principals are not involved in those agreements. Social partners only can request that designers and principals use their influence for the benefit of health and safety on the construction site.

European Directive 92/57 makes the client and the designer jointly responsible for decisions on health and safety in the design stage. Various evaluation studies and research on construction sites have shown the difficulty of implementing regulations in practical situations. In the Netherlands, for example, health and safety plans are generally not included at the end of the design phase. If there is a health and safety plan at all, it is likely to be a poor one and not of use for the execution phase.

New buildings have to meet criteria stipulated in the Buildings Decree. This Buildings Decree also states that a building permit is required before the start of the execution. The aim of the Buildings Decree is to ensure that the building can be used safely and evacuated in the event of an emergency. In the new Buildings Decree an extra criteria has been added.

TS9

6. Contractor safety management system – the refinery of Grupa LOTOS S.A.

Wioletta Golas – Grupa LOTOS S.A., Poland

The LOTOS Group, located in Gdańsk, Poland is a vertically integrated oil company, whose business encompasses exploration for and production of crude oil, processing of crude oil, as well as wholesale and retail sale of high-quality petroleum products. Grupa LOTOS is a major producer and supplier of such products as unleaded petrol, diesel oil and aviation fuel; it is also Poland's leading producer and supplier of engine oils, modified bitumens and paraffins. It operate a nationwide chain of petrol stations under the LOTOS brand.

Adherence to the concept of sustainable development and socially responsible business constitutes an integral element of the operations of Grupa LOTOS across all their areas: the Company seeks to minimise its environmental impact, values the intellectual capital and experience of its employees and is committed to furthering the welfare of society.

The LOTOS Group attaches great significance to the safety of persons both abiding and working on the company's premises. Labour safety and health protection are among its priorities. It is guided by the principle which states that *no work is as important and urgent as not to be delivered safely*. The Company also apply the principle of "zero tolerance" for negligence of rules and failure to comply with requirements concerning, among others; labour safety, and health, physical and fire protection.

While on the premises of the Grupa LOTOS or its subsidiaries, everyone is obliged to strictly adhere to the current law and internal rules of the company. Infringement of fixed

procedures and failure to comply with the rules is sanctioned by, among others, financial penalties, penalties involving temporary or permanent withholding of permissions to stay on the premises of the company, as well as prohibition to drive vehicles on the premises of the Grupa LOTOS.

The Company is equally committed to ensuring safety of its guests and contractors. To this end, third-party contractors:

- are given access to a dedicated website which distributes information on OHS/fire safety standards and requirements; and are furnished with the "Grupa LOTOS Site Rules and internal safety procedures",
- before entering the premises of the refinery, are handed the booklet "General Site Rules at Grupa LOTOS",
- before commencing work, they undergo training in internal safety rules and proper execution of work,
- are regularly assessed for compliance with the internal OHS requirements,
- are penalised with fines or temporarily/permanently prohibited from entering the Company premises in the event of non-compliance with the HSE rules and procedures,
- attend meetings with the LOTOS Group's employees devoted to internal work safety standards and most frequent irregularities in the area of health and safety at work.

Implemented contractor safety management system in refinery of Grupa LOTOS and safety level of employees and contractors is one of the LOTOS Group's priorities. Particular attention is paid to efforts aimed at maintaining high safety standards, minimising risks and reducing accident rates, while raising awareness of and promoting a culture of safe work. This has helped the LOTOS Group to earn the reputation of an employer offering a workplace that is safe, well-equipped and well-organised.

Parallel session TS10: Virtual Reality applications and advanced safety systems

TS10

1. A virtual reality pilot study towards elevating work platform safety and usability in accident prevention

Peter Nickel, Andy Lungfiel, Georg Nischalke-Fehn, Michael Huelke – Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA), Rolf-Jürgen Trabold – German Workers' Compensation Board for "Trade and Distribution of Goods" (BGHW), Germany

Analyses of accidents with mobile elevating work platforms (MEWPs) identify falling and crushing as major hazards with a high level of annual fatalities. Operator training and MEWP safeguards design as measures to prevent accidents take long to become effective at the shop-floor level and those measures under development can neither be evaluated beforehand nor in the context of use, avoiding the risk placing operators or others in danger. Therefore, an occupational safety and health (OSH) project aims to evaluate the usability of a prototype supplementary MEWP safety related measure in an industrial work environment, using virtual reality. Initially, contributory conditions to crushing as a major hazard have been identified. A pilot study informed the suitability of virtual work scenarios and of tools for usability assessments. Preliminary results suggest the prototype safety measure being suitable in terms of not disturbing normal MEWP operations. The usability in accident scenarios, however, requires further investigation. OSH may take advantage of VR as future implementation of prevention measures can be accelerated early on.

Keywords: Accident prevention, mobile elevating work platform (MEWP), supplementary safety related measure, usability, virtual reality, defeating safeguards, human factors

TS10

2. Improving OSH and performance indicators in European Manufacturing SMEs with help of Simulation and Virtual Reality: The IMOSHION project

Javier I. Millan – NEuropa Association, Spain

Every year 5,720 people die in the European Union as a consequence of work-related accidents, according to EUROSTAT figures. It is estimated that every three-and-a-half minutes somebody in the EU dies from work-related causes and that every four-and-a-

half seconds an EU worker is involved in an accident that forces them to stay at home for at least three working days.

SMEs are more vulnerable to work-related accidents than larger companies. These accidents can have a huge impact, both on human and economic levels. Such incidents cost the SMEs time and the availability of specific human expertise which directly translates into money and competitiveness. The reverse is also true: to reduce time to market decision times and high speed manufacturing are consequences which might lead to potentially greater risks for health and safety at work. To follow the many rules (all SMEs in Europe have to obey the national derivatives of the European Framework Directive (89/391/EEG)) can be a huge administrative burden.

IMOSHION's objectives consist of the application of new Occupational Safety & Health (OSH) tools, in order to increase OSH awareness, and to reduce accidents and occupational diseases, and therefore, increasing performance in European SMEs. With this in mind, the IMOSHION project focuses in two aspects: the collection of existing knowledge and the creation of new information concerning OSH issues, and the development of tools and techniques to raise awareness and improve OSH in SMEs.

TS10

3. An investigation in virtual reality on human factors requirements for human-robot-collaboration

Birgit Naber, Peter Nickel, Michael Huelke, Andy Lungfiel – Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA), Germany

Future industrial work should allow direct interactions of humans and robots in a collaborative workspace, i.e. working safely and jointly together in the same space of movement. While first design-related requirements for hazard prevention have already been agreed on internationally (ISO TS 15066), specifications for human factors and ergonomics requirements are pending. A virtual reality simulation study has therefore been conducted to investigate the impact of trajectorial speed and separation distance on operator safety, performance and well-being. In an industrial human-robot-collaboration (HRC) virtual work environment 14 operators performed a manufacturing component task on a notebook facing the robot. In parallel, operators performed a quality control task in direct interaction with the industrial robot. The results revealed effects of robot speed and distance on human behaviour in HRC and therefore may compromise operator safety and well-being. As a result, operator task performance tended to improve for a lower level of robot distance but for a higher level of speed. More clearly high robot speed at close

distance was perceived more hazardous than low robot speed at far distance. Although the empirical basis is too small to draw general conclusions the results provide preliminary evidence for the development of human factors and ergonomics requirements for safe HRC applications.

Keywords: Human robot collaboration, human system interaction, human factors requirements, virtual reality, robot speed, robot distance, work safety, operator well-being

Highlights

- Virtual Reality simulation of future human-robot-collaboration (HRC) work environment
- Explicate ergonomics and human factors requirements in HRC safety
- Effects of robot speed and robot distance on operator performance and hazard cognition
- Transformation in human factors requirement in HRC calls for a more substantial empirical evidence.

TS10

4. Freed from fences – Safeguarding industrial robots with ultrasound

Björn Ostermann, Michael Huelke – Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA), Anke Kahl – University of Wuppertal, Germany

Industrial robots work behind rigid safety devices in order to lower the risk that persons come in contact with the robot and thus to harm. The IFA, the institute for research and testing of the German Social Accident Insurance in Germany, is working on the state of science and technology in "collaborating robots", to grant humans safe access to robots.

In the course of the project "EsIMiP" (efficient and safe interaction of men and intelligent production assemblies), promoted by the Bavarian Research Foundation, and an accompanying dissertation at the University of Wuppertal, a concept was developed by the IFA that allows the robot's arms to be secured by the use of ultrasonic sensors. It enables a flexible collaboration between human and robot.

The ultrasonic range sensors are arranged as an array around the robot's arm. This allows the robot to sense the free space in its near vicinity. The sensors are arranged in an overlapping manner, enabling the sensors' control to detect failure in a single sensor.

The sensor control is directly communicating with the robot's control, receiving the robot's goal points in advance. Thus the sensor control can simulate the movement of the robot in

advance, detecting dangerous behavior and possible collisions between the robot and its environment. If such dangerous situations are imminent, the sensor control can safely send a command to the robot's control inducing a reduction of the robot's speed, up to the point of a stand still of the robot.

The safe execution of the predicted movement and the speed reduction is monitored by a separate safety control, provided by one of the research partners in EsIMiP.

TS10

5. Advances in Active Near-Infrared Sensor Systems for Material Classification

Holger Steiner, Oliver Schwaneberg, Norbert Jung – Bonn-Rhine-Sieg University of Applied Sciences, Germany

This paper presents an active multispectral scanning sensor capable of classifying an object's surface material in order to distinguish between different kinds of materials and human skin. The sensor can be used in conjunction with safeguarding equipment at manually-fed machines or robot workplaces, for example. Recent research shows how extended sensor systems and advanced material classifiers can be used to provide additional value by distinguishing different materials of work pieces in order to suggest different tools or parameters for the machine (e.g. the use of a different saw blade or rotation speed at table saws). Additionally, a first implementation and evaluation of an active high resolution NIR-camera system addressing new safety applications is described. Both approaches intend to increase the productivity and the user's acceptance of the sensor technology.

Keywords: safeguarding equipment, optical sensors, multispectral sensors, near-infrared imaging, machine learning

TS10

6. ICT based mobile training facility supporting safety shaping in the mining industry

Teodor Winkler, Łukasz Jaszczyk, Dariusz Michalak – Institute of Mining Technology KOMAG, Poland

In the current economic climate, prototypes of large mining machines are very rarely manufactured. The newly designed and manufactured machine is normally directly transferred to the end user. The degree of complexity involved in building these items of

the machinery is very high. Mechanical, electrical, electronic, hydraulic, pneumatic and water systems are often all operating at the same time in each item of the equipment.

The process of designing and manufacturing a new mining machine can now be completed within a much shorter time. This is due to a broader use of CAD methods in the designing process and CAM technology in the manufacturing process. So, in consequence, less time is available to allow future operators and service staff (who keep the machine in operation) to become acquainted with the machine design. Existing training centers, equipped with traditional educational materials, have no state-of-the-art design solutions at their disposal. This means that their training programs become outdated very quickly and contain no specific information relevant to the new machine being manufactured.

Concept of mobile training facility, which enables to overcome these limitations and which is based on such components of ICT technology as: RFID tags, handheld computers (PDA), Augmented Reality, is presented in the paper. Movable training stand consists of real training object (e.g. mining machine) and virtual network of the components of specialistic knowledge combined in a scenario driven training program. Knowledge is delivered to the training participant, in the places and situations planned in a training scenario, by Augmented Reality or PDA. Mobile training facility enables simultaneous shaping of professional competences and dissemination of safe work methods. Examples of trainings of operators of mining suspended monorails and fitters of mining machines are presented. Training scenarios, including trainings with use of serious games, are discussed.

Parallel session TS11: Economic and social aspects of safety

TS11

1. Application of CBAOHS model in the economic evaluation of risks and preventive measures

Delfina Ramos, Pedro M. Arezes, Paulo Afonso – University of Minho, Portugal

A model of cost/benefit analysis in occupational health and safety (CBAOHS) supports economic evaluations of the measures of risk treatment, where expected total costs are weighed against the total expected benefits in order to choose the best option. The applicability of techniques and tools such as cost/benefit analysis (CBA) for risk management and risk assessment is indicated in ISO/IEC 31010 (2009).

In a CBAOHS model both tangible and intangible costs and benefits should be considered, as well as direct and indirect costs and benefits. Quantitative CBA aggregates the monetary value of all costs and all benefits to all stakeholders that are included in the scope, adjusted for the different time periods in which costs and benefits accrue. Thus, the decisions to be made can be based on the analysis of the Net Present Value (NPV), the internal rate of return (IRR) or the ratio between the present value of benefits and present value of costs. In the situations involving risks to human life or damage to the environment the ALARP principle may be applied (as low as reasonably practicable).

This paper presents and discusses this model for economic assessment in the context of risk management, which may be used to support decision making. The presented model is validated through the analysis of target sectors. A case study involving a hospital is presented.

TS11

2. A management accounting perspective on safety

Sari Tappura, Matti Sievänen, Noora Nenonen – Tampere University of Technology, Ari Jussila, Jouko Heikkilä – VTT Technical Research Centre of Finland, Finland

Management accounting supports decision making in organisations by providing managers with relevant information and analysis on performance, costs, and benefits of a certain operation. In safety-related issues cost-based calculations dominate practice, and typical measures include cost per injury or total cost of accidents. Monetary information is needed

to guide safety-related decision making. Besides focusing on financial information, management accounting should also focus on non-financial information, like safety improvement, strategic safety objectives, and employee relations.

In safety-related investments the monetary costs of an investment are usually well known but the monetary value of the benefits is very hard to calculate. Thus, there is a need for cost-benefit evaluation methods, including the non-financial benefits and value that is created though preventing accidents. In addition to calculating the safety investment costs, the efficiency of the improvements, such as productivity improvements and the value of safety goodwill, should be evaluated as well.

The objective of this paper is to chart current management accounting practices related to safety issues on the basis of findings from relevant literature. Moreover, we discuss the applicability of certain management accounting methods for safety-related decision-making and how these can be used to further improve current practices. The relevant methods include Balanced Scorecard, payback period, simple rate of return, and benefit-to-cost ratio. Valuing human life in cost-benefit analyses is also discussed.

Keywords: management accounting, performance measurement, cost-benefit analysis, safety investment, safety costs, balanced scorecard

TS11

3. Absence management as an element of OSH management in SMEs

Małgorzata Pęciłło, Marta Antoniak – Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Poland

In Poland in 2010 the number of days lost due to sick absenteeism amounted to 188 million, of which the number of days due to sick absenteeism financed by employers – 68 million. Because of limited human recourses absenteeism hits especially small and medium-sized enterprises (SMEs).

Most of researchers agree that work conditions are inconsistently associated with sickness absence rates. Moreover employees' health problems cause not only higher sick absence but also lower quality and productivity of work. According to the Eurostat estimations 20% of sick absence is caused by working conditions. In EU, in 2007 5.3% of employees suffered from health problems related to work, and 62% of them stayed on sick leave. In Poland (according to the Polish Central Statistical Office) every forth employee suffers from work' related health problems. To ensure outstanding safety working conditions that bring profits to employers by eliminating costs of lower

employees' well-being and consequently costs of sick absence occupational safety and health (OSH) activities could not be limited only to fulfilling the legal requirements but also should be aimed at ensuring participation of employees in OSH activities and at developing safety culture. The effectiveness of these activities is strongly influenced by quality of human recourses i.e. by the skills and expertise of employees responsible for OSH performance in enterprises.

The aim of the paper is to discuss, on the basis of researches, to what extent working conditions influence sick absence rates in small and medium sized and what is the role of the OSH management in ensuring low absence rates in SMEs.

TS11

4. Promoting safety for leisure time at the workplace – opinions of employers and staff

Toni Hyytinen – Tampere University of Technology, Finland

Traditionally, employers have carried out safety work only as a work-related activity, primarily because ensuring occupational safety is their statutory obligation. In Finland, an estimated 80% of accidents occur during leisure time. Leisure time accidents have mostly the same negative outcomes for employers as occupational accidents. Hence, as a novel approach, employers could promote safety for the leisure time of employees as well. In this study, the opinions of employers and employees about promoting leisure time safety at the workplace were obtained by interviewing individuals from 12 Finnish industrial companies and obtaining responses from individuals in the same companies to a questionnaire (510 respondents in total). Reactions of individuals for promoting leisure time safety at the workplace were very positive. All the 12 participating companies were interested in promoting safety for leisure time and believed that positive results could be achieved by such activities. In addition, only 2.6% of respondents were set against promoting safety for leisure time by employers. Both employers and staff agreed that promoting safety for leisure time could positively influence to occupational safety through improved safety culture. The results of this study encourage widening the perspectives of promotion of safety by employers.

Keywords: Leisure time safety, safety management, preventing accidents, promoting safety

TS11

5. Safety management in small and medium enterprises of manufacturing sector: The case of Andalusia

Jesús A. Carrillo, Ventura Pérez, Luis Onieva – University of Seville, Spain

There are many evidences that small and medium enterprises (SME) have more proportion of severe accidents than big companies whereas slight accidents such as sprains and strains are less frequently reported by SME. Injury rates in Andalusian manufacturing sector are higher for SME than in micro and big companies for traumatic accidents. In SME the proportion of fixed term contracts, young and low qualified workers are higher.

Understanding the root causes of this phenomenon is needed in order to apply appropriate preventive actions, especially at macrolevel. We have analyzed what are the underlying differences in safety management depending on company size in Andalusian manufacturing sector using three tools.

First of them is the I Andalusia Survey of Management System. We have identified which variables show significant differences depending on company size. SME companies have different resources and safety practices according to this survey.

Second, we have analyzed a set of official investigations of accidents in order to identify what organizational and safety management causes are more frequent in SME companies. Inadequate work method, lack of training or lack of safeguards have been more frequent in investigated accidents of SME. Not using PPE or not complying safety rules only were found among investigated accidents of SME.

Finally, we have data from a public assessment program for high injury rate companies. In that program, an official assessor gathered information about safety management deficiencies.

Company size can affect the decision of subcontract or not safety activities. SME should take into account that subcontracting safety assessment cannot substitute internal resources needed to develop the safety practices. There are difficulties in implementing the preventive actions defined according to the accident investigated. Further research needs to be done in order to reveal how "make-or-buy" decisions about the safety activities can affect the effectiveness of safety management.

TS11

6. Family as a safety factor

Line Richter, Sisse Grøn – Centre for Maritime Health and Safety, University of Southern Denmark, Denmark

Previous studies have shown differences in accident rates among colleagues of different nationality, one was a study on Danish ships, which showed the lowest rate among Filipino seafarers, while Danes had the highest. Centre for Maritime Health and Safety is conducting the SADIS project in order to learn what lies behind these figures. In particular, we have directed our focus towards the reporting practice and the safety culture as explanatory factors.

Safety practices is not only a matter of safe or unsafe events and actions; it is an aspect of the whole of the individual actor's social life.

Following recent literature the family ties of the Filipino seafarer play an important role in life on board the ship. We extend this notion and look at how safety practices may be related to the family relations of the individual seafarer. Although most studies point to the strong influence of Filipino family ties our study indicates that the family relations of Danish seafarers also play a role on their life aboard and we explore how this influence the safety practices of the individual seafarer and discuss what difference it makes.

Based on ethnographic fieldwork conducted on board ships with multinational crews and land based in Denmark and the Philippines, this presentation will investigate what the role of the family is in the safety practices of seafarers.

Parallel session TS12: Safety in specific sectors: transport and construction

TS12

1. Safety in the transport sector

Kirsten Jørgensen – Technical University of Denmark, Denmark

In EU the transport sector has an incident rate of accidents at work at 40 pr 1000 employees. The Danish insurance company CODAN has insured a big part of this sector concerning transport of gods on shore.

The purpose of the project is to document the safety problems in the sector and to develop a strategy for a preventive intervention in transport enterprises. The results will in the end be included in a new strategy for the insurance company and the transport sectores organization towards a better safety performance.

The safety problems for the employees are the activities carried out by loading, unloading or work with transport equipment carried out at many different work places. The main safety problems are falls, heavy lifting, poor ergonomic working conditions, hits or collisions with gods, equipments or falling objects, the traffic risk situations, work with animals and finally the risk of violence and robbery. The transport branch is characterized by many small enterprises of which 97% of the enterprises in Denmark have less than 50 employees and 89% have less than 10 employees.

The intervention in 5 small enterprises show a relevant focus on both the risk for occupational accidents but also the risk of accidents that have consequences for the cars and the deliveries to customers. A calculation of the internal costs of compensation of all damages and injuries shows an amount that covers 20–100% of the enterprises profit for a year.

The intervention in the enterprises is a simplification of safety management methods but adjusted into a new focus and awareness for the managers of small enterprises. What really matters is to teach the managers to manage and focus on both safety and quality connected with time schedules and costs.

TS12

2. Balancing aviation security against flight safety – results from a survey in a Norwegian regional airline

Torkel Bjørnskau – Institute of Transport Economics, Kenneth A. Pettersen – University of Stavanger, Norway

This paper reports the results from a survey of perceptions and consequences of aviation security measures in a Norwegian regional airline. The study was conducted in the spring and summer of 2010, and contains responses to questions about security measures from 675 employees; 340 pilots, 151 cabin crew, 129 ground personnel and 55 technicians. The response rate was 83 percent.

Security control of pilots and other groups of aviation employees was introduced at large and medium-sized airports in Norway in 2004 and at the country's short-runway airports in 2005. The airline typically flies to short-runway airports where the zones that have received security clearance, so-called "clean" zones, are smaller than at larger airports. The weather service, cantina and toilet used by the flight personnel are often located outside of the "clean" zone at a short-runway airport, but within this zone at larger airports. This fact, combined with bus route-like flights with frequent stops, means that employees might have to undergo a security check many times during the course of a work day.

A factor analysis (PCA) of the survey data identified four significant factors: "Communication", "Reason", "Frustration" and "working environment". The variables used as a basis have high internal consistency (Cronbach's alpha 0.94-0.78). Regression models reveal that the employees, especially the pilots and technicians, feel that the security control leads to frustration, poorer communication and a less satisfactory working environment. They also find it to be unreasonable.

The employees give a number of examples of how negative experiences from the security check have made them feel irritated, weakened their concentration or in another way had an impact on human factors of significance for flight safety.

TS12

3. Onboard work accidents in civil aviation in Denmark

Johnny Dyreborg – National Research Centre for the Working Environment, Denmark

Background: The emergence of a range of low cost airlines and increased competition in the civil aviation in Europe and internationally might represent a challenge to the onboard work safety. Even safety is an important part of the air traffic system the onboard

accidents contracted by flight and cabin crew members have not been given appropriate attention. More than thirty airlines are registered in Denmark, of which only eight use cabin crews. The aim of this study was to estimate the development in the incidence of onboard work accidents in the civil aviation in Denmark and to identify typical risk situations for flight and cabin crews.

Methods and material: Cases of onboard accidents reported to the Danish Transport Authority, hours of duty (block flying time) and number of take offs, were collected in the period 2005–2010. These data were used to estimate the incidence of accidents among flight and cabin crew members. Observations were conducted on different types of flights in operation during short and long haul flights. Interviews were conducted with flight and cabin crew members in order to identify typical risk situations related to the duties in the cabin and the operation of the aircraft. The accident reports, observations and interviews provided a basis for the description of the main risk factors related to onboard accidents.
Results: There were no significant changes in the incidence of accidents in the study period. A number of risk situations were identified on board, e.g., problems with the trolley used for serving of the customers, turbulence and falls against inventory, hard landing and the condition of the jump seat. Some types of flights seem to pose more problems than others, which can be difficult for national authorities to influence.

TS12

4. Stress on the bridge of offshore vessels. An example from the North Sea

Jon Ivar Håvold – Ålesund University College, Norway

This paper reports results from a survey on 157 navigators (bridge officers) from eight offshore companies operating in the North Sea. The questionnaire measured stress, work pressure and sleep/rest (fatigue). Sleep/rest and work pressure explained around 35% of the variation in stress. Work pressure increases stress, and sleep and rest reduce stress both directly and through reduced work pressure. A positive work climate/supportive culture reduces stress on the bridge substantially through reducing work pressure and improving sleep and rest quality. The research indicates that age and the length of time that respondents have been seafarers do not have any influence on stress. However, a significant difference at the 10% significance level was found in relation to occupation (between first mate and other navigators). Around 30% of the respondents reported unsatisfactory sleep and rest during a normal day. More than 10% of the respondents reported that senior management was not interested in their health and safety, and more than 15% of the officers reported that they took short cuts to get their work done.

Keywords: Stress, sleep, work pressure, offshore-vessels

TS12

5. Occupational Health Impact Assessment. Comparison of health and safety at work

Henk Jan Manuel, Paul Uijt de Haag – National Institute for Public Health and the Environment (RIVM), Linda J. Bellamy – White Queen BV, Ioannis Papazoglou – NCSR Demokritos, Martin Damen – RIGO Research & Advies, Joy Oh – Ministry of Social Affairs and Employment, The Netherlands

Workers are exposed to risks at work related to health and safety, for example exposure to harmful substances, physical stress and accidents. To reduce these risks, interventions can be done and decisions have to be made which measures need to be implemented. For a cost-effective intervention, we need to know which risks are the most important for specific jobs and how the measures will affect the different risks.

In this project, we compared the different types of risk for a selection of jobs in the construction industry. First, we selected the jobs and risk agents and diseases, using as criteria the relative importance and the availability of data and models. Four construction jobs were selected, namely carpenter, tiler, concrete driller and road paver. For these jobs the exposure to silica dust, physical stress, dermal irritants and occupational accidents were determined. Next, life tables were used to follow the populations in these jobs in time to calculate the occupational burden of disease. As a common measure, we used the number of Disability Adjusted Life Years (DALYs) caused by death or injuries resulting from exposure. This gave the opportunity to determine the relative importance of different health and safety related diseases for different job types.

In an uncertainty analysis, the parameters of the model were investigated and the uncertainty in the occupational burden of disease was calculated. With this analysis, the relative importance of the different parameters was determined to guide future improvements in the model.

A mock up of the model was made to demonstrate the possible use in practice. In the presentation the model will be demonstrated and we will discuss the work done and its practical application.

TS12

6. Flow diagram analysis of electrical fatalities in the construction industry

Chia-Fen Chi, Yuan-Yuan Lin, Mohamad Ikhwan, Syuan-Zih Lin – National Taiwan University of Science and Technology, Taiwan

Electrical fatality accounted for 14.6% of all fatal accidents and was the second leading cause of occupational fatality in Taiwan following the fall fatalities. We analyzed 250 work-related single fatalities of electrocution in construction industry from 1996 to 2002. Each fatality was coded in terms of age, company size, experience, performing tasks, source of injury, accident cause and hazard pattern. The Chi-square Automatic Interaction Detector (CHAID) was applied to the coded data of the fatal electrocution to find a subset of predictors that might derive meaningful classifications or accidents scenarios. A series of Flow Diagrams was constructed based on CHAID result to illustrate the flow of electricity travelling from electrical source to human's body. The flow could be through an intermediary object or directly to human body part. The Flow Diagram can then be used to implementing barriers by cutting the trace between electrical source and victim.

Parallel session TS13: ENSHPO Session: Education, training and personnel certification

TS13

1. Certification of safety professionals: emerging trends of internationalisation

Andrew Hale – Health and Safety Technology and Management Ltd (HASTAM), UK; Hazel Harvey – Institution of Occupational Safety and Health, UK

Professionalisation of safety began at a national level with the formation of national associations of safety staff working in industry and of government inspectors. It took its first steps towards international harmonisation with attempts in the 1970s in Western Europe to arrive at agreement on the content of university level courses. The European harmonisation was boosted by the initiative of the ISSA (International Social Security Association) Safety Training Section, later taken over by ENSHPO (European Network of Safety & Health Professional Organisations), to document the regulatory schemes and the range of roles and competences of safety professionals across Europe. Transportability of professional qualifications became one of the important issues under discussion within the European Union This led to the development of two ENSHPO standards, for certification of safety managers and safety technicians. These have, in turn, influenced some participating countries, such as Italy, Malta and Russia to amend and upgrade their national qualifications, or to model their newly developing qualifications on these standards. A European project, EUSafe, is currently taking a further step to develop the standards into exemplary role and task descriptions, learning objectives and teaching protocols which can be used to stimulate further training initiatives and lead to further harmonisation of training requirements. Initial work included a review of the education programmes that already exist in the EU and identified the states where there is a legal requirement for safety professionals. Based on the UK National Occupational Standards for safety detailed profiles of occupational competence for individual professionals have been identified indicating what a health and safety professional should be able to do. These have been turned into learning outcomes for professional courses at different EQF (European Qualifications Framework) levels. This European development has now combined with a parallel development internationally under INSHPO bringing together North American and Asia Pacific countries to share and learn from each other's certification and accreditation systems.

TS13

2. European post graduate courses on occupational health and safety, a general overview

Paul Swuste – Delft University of Technology, The Netherlands;
Pedro M. Arezes – University of Minho, Portugal

The education of safety professionals shows a high variety in their level of approved qualifications. In European countries, the characteristics of these courses differ quite a bit, referring to national particularities, legal issues, and the nature of the institutions and people "behind" the courses.

This paper presents the results of a survey carried out in the scope of an European research project and it aims at a basic understanding of the range and diversity of the OHS post-graduation courses. With an estimated average answer rate of 50%, the survey has only included courses with more than 120 teaching hours, from a post-graduation level, and with complete programs. Results are presented for 90 courses, from 18 countries, mainly (84.4%) from universities.

As expected, the majority of the courses (59%) are Masters (or equivalent), and are organised primarily by Engineering, Applied Sciences and Management, schools/faculties, which together accounted for nearly 65% of the courses. As a quality system, these courses use predominance (65.8%) "internal" tools, such as the students and teachers evaluations and internal audits. These internal tools are a are not a great motivator to adapt courses to dynamics in both safety science domain and society. Given the fact that the number of post graduate courses have increased substantially after the Bologna declaration, one might expect that commercial interest in post graduate OSH education has increased. On itself this should not be a problem, if courses are actively stimulating academic qualities of students, like a focus on problem solving instead of rule following.

One of the main conclusions is that there is a large variability amongst the analysed courses. Considering the identified differences within all the European countries, the harmonisation of post-graduation courses on OHS, if it is to occur, has a long way to go.

TS13

3. Post-graduate courses on occupational safety and health in Portugal – a preliminary analysis

Pedro M. Arezes – University of Minho, Portugal; Paul Swuste – Delft University of Technology, The Netherlands

In some European countries the profile and competencies of the occupational health and safety professionals are strictly linked with their education and training courses they

attend. Therefore, to understand the way professionals are trained and educated it is necessary to know in detail the courses and its characteristics. This presentation will give a summary of the results of a survey of post-graduate and MSc courses on occupational safety and health. The survey is restricted to three Portuguese university courses, namely two MSc. courses, at the universities of Minho and Porto, and a post-graduate course, at the New University of Lisbon. The presented results were obtained by interviewing the course coordinators for a period of approximately 2 hours per course. The interviews were designed to address four main topics: course structure, certification, quality system (and changes implemented), research activities related to the course organizers, and the possible dominance of a particular "safety science school". According to the obtained results, it is possible to verify that some of the differences between courses are related to the hours spent on specific topics. These differences can be traced back to the history of the course, the specialization of the school or the faculty developing the course, and the availability of knowledge on scientific domains within each university. Despite that, the similarity between the analysed courses is much more prominent. All courses are fed by research, by educating students not only in easy-to-use tools, but also in underlying theories, models and metaphors of relevant disciplines. All courses are homologated by governmental bodies, and certified by a 3rd party, or planned to do so in the near future. This certification is a legal requirement, considering that the successful conclusion of one of these courses can be used to apply for a personal certification as safety manager.

Keywords: safety, education, post-academic courses, Portugal

TS13

4. Improved safety by setting common standards for training

Johan Nylander – SSG Standard Solutions Group, Sweden

Contractors working in the industry are exposed to several risks and often stressful working conditions. In order to reduce accidents and incidents where contractors are involved an initiative was taken by the pulp & paper industry in Sweden, 2006. The ideas behind the initiative were to ensure that all contractors working in the industry had access to a safety training program at moderate cost and easily accessible.

This has led to the concept SSG Entre, a webbased safety training used by most sectors in the Swedish industry. Besides a general safety training the concept includes the possibility of adding a module with company specific information. Here local guidelines, typical risks, how to behave in an emergency situations can be added.

After the training a personal certification test is performed which when approved leads to the issue of a Safety passport. This passport is valid for three years and is also valid in the Finnish industry. The general safety training is revised by an industry committee on a yearly basis and the material is thereby continuously updated.

As well the industry as the contractor companies has access to the database where information about approved individuals, participating companies etc can be found.

100 000 contractors from more than 30 countries has now gone through the training. The training is accessible in the following languages: Swedish, Finnish, German, English, Polish, Italian, Norwegian.

As a spin off similar standardized trainings programs have been developed for the employees at the industry and several thousands have been trained in areas such as occupational safety, fire safety and environmental control.

In Europe work is going on to harmonize and standardize training for contractors. The safety network ENSHPO has started up a project where the target is to set standards for a European Safety Passport.

TS13

5. Towards harmonized European Safety Card Training

Päivi Rauramo – The Centre for Occupational Safety, Finland;
Andrew Hale – Health and Safety Technology and Management Ltd (HASTAM), UK, Delft University of Technology, The Netherlands;
Johan Nylander – SSG Standard Solutions Group, Sweden

Global challenges in working life necessitate global cooperation also in occupational health and safety. The advance of globalisation has resulted in cross-border mobility of workers becoming an important topic in occupational safety and health (OSH). Aspects such as migration, multi-national corporations and free movement of workers have an increasingly important role to play in health and safety.

Safety Card/Passport Training Systems have become a popular and effective way to complete the basic training in safety and health at work in many European countries. Voluntary Safety Cards for common and specific industry sectors are in place in many members states. The target populations are workers and supervisors of contractor companies at construction and maintenance worksites, shop floor workers and supervisors of industrial and service companies and personnel of public agencies, institutions and

educational bodies. These different safety passport schemes have been developed to provide a way for ensuring that employees have the basic knowledge on occupational safety and health.

There is currently no system for the mutual recognition of different safety cards, which results in individuals often requiring several passport cards as they move from one employment or contract to another. The content of training in the various passport schemes differs from each other somewhat, but there is a common core which can form the basis for certification of comparable schemes (VTT Uusitalo 2007). There is a need for a system that would ensure that safety passport holders do not have to repeat the core training if they move from one employer, contract or country to another. This can be achieved by a process of assessment against agreed criteria covering the arrangements made by a card issuing organization for the training and examining of the card holders.

The European Network of Safety and Health Professional Organizations (ENSHPO) has taken up this challenge to develop an European-wide recognition system for certification of safety passport schemes.

Parallel session TS14: Risk perception and behavior modification

TS14

1. Sensitizing youngsters for future safe and sustainable behaviors: Think Safety Project!

Cláudia Fernandes, Luís Rocha – Technological Centre for the Metal Working Industry (CATIM), Portugal

Everlasting mentality shift must begin at tender ages, using methods and techniques that allow youngsters to make connections with everyday life contents and situations. Think Safety Project! (TSP) is directed at youngsters, their teachers, tutors and parents. It aims to raise awareness on: i) early risk detection and prevention; ii) the importance of the adoption of safe behaviors. TSP in based on project-based learning, and the foundations for activity design and adult interaction, were: a) Promoting experiences with pedagogical and practical objectives; b) Functioning has a role model by observation and promotion of self-opinion; c) Create settings that allow youngsters to question, to think and to experiment; d) Create settings that allow youngsters to experience safety in simulated and similar to real environments; e) Promote autonomy; f) Sensitize youngsters for technical careers related with industry; g) Sensitize youngsters, teachers, tutors and parents for the importance of the promotion of a safety culture; h) Give knowledge of different real industrial settings concerning safety, risk analyses and safe behaviors.

The activities also allow youngsters to: a) Give new meanings to reality; b) Develop and test new ideas; c) Rationalize impacts of their behaviors in either real or simulated settings; d) Promote global awareness on the importance of safe behavior adoption, and their impacts on society, industries and citizens; e) Promote global awareness of industrial processes and the importance of the human factor; f) Take on safety habits (own and within their families).

Has the outputs of the project it will be explored the initial and final perceptions concerning behavioral assets of health and safety in society and at work/industrial settings. Some of the questions that we intent to answer during the project are: Can perceptions be altered? What are safe behaviors? What's the role of safety in everyday life? Why have safe behaviors?

Keywords: Safety, sustainable behaviors, behavioral change, youth

TS14

2. Safety percpetions on high-speed crafts: A multilevel perspective

Jørn Fenstad, Trond Kongsvik – Norwegian University of Science and Technology (NTNU Social Research), Gunnar Lamvik – SINTEF Technology and Society, Norway

The safety in transport systems is influenced by actors on different societal levels, e.g. regulators, company administrators and operative staff. Rasmussen (1997) claimed that there is a need to consider the interaction among levels of socio-technical systems in safety research. In the present study we have explored a multilevel perspective on safety perceptions. Using crews on Norwegian express boats as an example, we quantitatively investigated the relative influences of regulative authoritys policy instruments, the ship-owners safety efficiency-safety tradeoffs and crew safety climate on safety perceptions in the sharp end. The empirical basis for the study is a questionnaire survey involving 261 crew members (response rate 55%). By means of structural equation modelling, we illustrate the direct and indirect effects of the different factors on safety perceptions. The study contributes to the understanding of how framework conditions influence cultural aspects of safety and safety perceptions.

TS14

3. Team resilience: a literature study

Dolf van der Beek, Niek Steijger, Johan van der Vorm, Raphaël Gallis – The Netherlands Organization for Applied Scientific Research (TNO), The Netherlands

Teams are an important linkage to enhance organizational resilience; which is according to Hollnagel "the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations even after a major mishap (or in the presence of continuous stress)". They are exposed to a wide variety of demands from their complex operational environments and have a profound reservoir to prevent potential damage, to take advantage of opportunities, or to cope with (negative) consequences. Team resilience could be described as a team ability to meet these demands by 1) monitoring of, 2) responding to, 3) anticipating of, and 4) learning from unexpected events.

However, these abilities of resilience still need to be operationalized into measurable and changeable constructs. The goal of this study is a) to identify team behavioral determinants, and b) to develop a conceptual model of team resilience, and c) to describe the development of an instrument to measure team resilience.

Based on a literature review several conditions, processes and outcomes were selected that had to meet three criteria. They had to be 1) relevant for achieving and maintaining team resilience, 2) easy to measure, and 3) offer opportunities for team members to improve team resilience (changeable). Team resilience appears to be consisting of various cross-level determinants highlighting a focus on team processes rather than team outcomes. An existing input-throughput-output model is improved which illustrates a series of phases unfolding over time that constitute the core processes and emergent states underlying adaptive team performance and contributing to team resilience.

In 2012 the model and measurement instrument will be validated by applying them to electric power engineering maintenance teams. Aim is to develop a tool that identifies and visualizes the feedback on team resilience to the team leader.

TS14

4. A multi-case study of the implementation of an integrated approach to safety in small enterprises

Kent Jacob Nielsen, Louise Moeller Pedersen, Lars Peter Andersen, Dorte Raaby Andersen – Herning Hospital, Pete Kines – National Research Centre for the Working Environment, Denmark

Background. An integrative approach to managing safety has been proposed by David DeJoy. It is based on a combination of the behavior change and culture change approach to safety. The key features are a data-based and participatory problem-solving process and an explicit culture change process.

Objective. The aim of the current study was to test the implementation of an integrative approach to safety in small (20–49 employees) enterprises within the metal and wood processing industries in a quasi-experimental, multi-case design with 2 intervention (I1 & I2) and 2 control enterprises.

Methods. Baseline measures included safety observations, questionnaires, interviews and inspection of machine safety. The intervention consisted of workshops where the health and safety organization, workers and supervisors discussed safety issues identified at baseline (the problem solving process), and a short workshop on safety management and leadership, followed by a number of individual safety coaching sessions with supervisors (the culture change process).

Results. The results differed between the two intervention enterprises. At I1 supervisors performed 80% of the activities planned in the coaching sessions and 74% of the activities

from the worker workshops, and 82% of the activities from the HSO workshop were resolved, compared to only 48%, 59% and 20% respectively at I2. Interviews with management and workers indicated a difference in management commitment to the process in the enterprises, and a lack of trust and perceived reciprocity between workers and supervisors at I2. The effect measures showed improved safety leadership, safety knowledge, safety involvement and machine safety at I1 at follow-up and no improvements at I2, as was also the case for the two control enterprises.

Conclusion. The results show that it is possible to implement the approach successfully in small enterprises, although further studies are needed to link the approach to culture change. It is crucial to ensure management commitment throughout the implementation.

Keywords: Integrated approach to safety, small and medium enterprises (SME), coaching, intervention, safety culture

TS14

5. Risk perception, safety attitudes and compliance with safety and security regulations and rules – challenges for safety managers in Norwegian network companies

Ruth Østgaard Skotnes – University of Stavanger, Norway

This paper addresses how managers and employees in Norwegian network companies perceive the risk of electric network failure (loss-of-supply) caused by accidents in, or attacks on, their ICT systems, and how risk perception can affect the safety culture in these organizations. During the last three decades, the Norwegian electric power supply system has become more complex, due to large-scale implementation of new technology, i.e electronic components and ICT systems. The Norwegian society relies heavily on electricity, and critical infrastructures have become increasingly interdependent. An accident in, or attack on, the ICT systems that monitor, control and operate power generation plants and power distribution within the electric power supply system, may have serious impacts on the physical grid, and can not only result in a major financial disaster but also in devastating damage to public safety and health.

The research methodology is based on a survey, where statistical data is collected from managers and employees in a sample of network companies within the Norwegian electric power supply organizational field. Two research hypotheses are tested:

1. Most managers and employees in the Norwegian electric power network companies perceive the risk of a breakdown in the organization's ICT systems caused by an accident or an attack as lower than the government and risk experts.

2. The risk is perceived as low partly because few serious incidents/accidents have occurred in Norway so far, and due to the complexity of the ICT systems.

Results suggest that "inaccurate" risk perception concerning ICT safety/security affects the safety culture in the network companies, and creates a challenge for the organizations' safety management.

TS14

6. Occupational accidents in the Netherlands: prevalence, mental harm, and the relation with psychosocial factors of work

Marloes van der Klauw, Karen Oude Hengel, Maartje Bakhuys-Roozeboom, Lando Koppes, Anita Venema – The Netherlands Organization for Applied Scientific Research (TNO), The Netherlands

Based on the Netherlands Working Conditions Survey, the current paper investigated the prevalence of occupational accidents in two sectors, the construction industry and health and welfare sector. More specifically, the present study aimed to investigate the prevalence of mental harm due to occupational accidents for the two sectors and investigated the relation between psychosocial factors of work (i.e. job autonomy, time pressure, violence and harassment by colleagues, supervisors or by people outside the organization) and the occurrence of occupational accidents in the Netherlands for the two sectors. Firstly, analyses revealed that occupational accidents in the construction industry more often involved physical harm in comparison to other sectors, and that occupational accidents in the health and welfare sector relatively more often resulted in mental harm than occupational accidents in other sectors. Moreover, multivariate analyses on the relation between occupational accidents and psychosocial factors of work showed that psychosocial factors were associated with occupational accidents in both sectors. Regarding the construction industry, high time pressure and exposure to violence and harassments by colleagues or supervisors were associated with occupational accidents. Regarding the health and welfare sector, low autonomy and exposure to violence and harassments by colleagues or supervisors or by people outside the organization (i.e. patients or clients), were associated with occupational accidents. In conclusion, the present paper stresses the importance of also taking psychological consequences and psychosocial factors of work into account in assessing the occurrence of occupational accidents.

Keywords: Occupational accidents, safety, psychosocial factors of work, mental harm, psychological consequences

Parallel session TS15: Ergonomic analyses and solutions

TS15

1. Adoption of ergonomic innovations in the construction industry

Bosse Glimskär, Tore J. Larsson – KTH Royal Institute of Technology, School of Technology and Health, Sweden

Objective. This study is an attempt to describe some factors that govern the adoption of ergonomic innovation in the construction industry.

Methods. Floor layers constitute an occupational group within the construction industry that has been studied in-depth. This study has examined the current situation with regard to the use of, the incremental innovation, the "glue spreader" 20 years after its introduction on the market. Forty-nine companies, statistically representing different company sizes and geographical distributions, responded to a questionnaire. The questions in the questionnaire dealt with variables that resulted in failure to use the glue spreader.

Results. The study shows that 90.5% of the participating companies had at some point tried doing gluing work standing up, only 34.1% indicated that they presently were using the glue spreader. A number of reasons have been advanced in defence of this behaviour: gluing is just a small part of the job, the glue spreader is cumbersome to take along, they do not want changes at work, it takes too long to relearn, or their colleagues do not use it. However, what is a bit more salient is the assertion that the gluing work cannot be done fast enough with the glue spreader.

Conclusion. Changing a working method or using a work aid that reduces the risk of MSD injuries also requires that there be an improvement in terms of compensation/production economy for the individual if they are to be motivated to change the way they work.

TS15

2. Manual handling of waste containers

Claus Backhaus, Karl-Heinz Jubt, Christian Felten, Jörg Hedtmann – German Social Accident Insurance Institution for Transport and Traffic (BG Verkehr), Marcus Post, Rolf Ellegast – Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA), Germany

The study determined hand forces and trunk postures during pushing and pulling of two and four wheeled waste containers in a laboratory set up to estimate the work load of refuse collectors.

To capture initial and sustain hand forces three dimensional force detection handholds will be fixed at the waste containers. Anymore we used a biomechanical motion analysing system (CUELA) to analyse the trunk position. In a laboratory set up with the handling sequences: straight, barricade, decline and incline (8%) garbage collector (n = 10) move the full and half full filled waste containers in usual work speed.

During the handling initial hand forces from 88 to 358 N und sustain hand forces from 32 to 163 N were measured and sagittal trunk flexions from -6° to 24°, lateral trunk flexion up to 3° and trunk torsion up to 7° occurred.

The results show that initial hand forces in amount of the 10. percentile for male maximum forces will be required to move the waste containers. Recommendations for initial and sustain hand forces which results from psychophysical measuring and define a level of acceptance for an eight our working shift are partly exceeded. By the combination of hand force during sagittal and lateral flexion w torsion of the trunk the manual handling of waste containers leads to a high level of stress especially to the lumbar spine of the subjects.

TS15

3. Ergonomic innovation for formwork platform made by reinforced concrete slab; the system was the BNOJACK electric system

Bruno Bisson – International Social Security Association (ISSA), France

The Bnojack lifting system designed a mechanical mean to lift the formwork platform of the reinforced concrete slab for building the construction. It allows doing the formwork at breast height avoiding heavy work tasks related to the formwork.

The Bnojack system is comprising a variable number of electrical jacks (modular device), which are autonomously powered by 24 Volts batteries and radio-controlled by a remote command system.

The design of the Bnojack system concerning the mechanical and electrical parts, as well as regards the command and control software, involves many features to ensure a maximum safety during each phase of its operations.

The Bnojack system got its certificate of conformity to the 2006/42/CE norm from Bureau Veritas, which relates to machines' safety.

The main components of the Bnojack system are designed and manufactured by major European industries, which insures a safe and reliable use of the system throughout the years.

Actually, that working position drastically improves the safety, the ergonomics, the easiness and the rapidity during operation of building up or disassembling the forms.

The Bnojack system is therefore giving new opportunities to decrease accidents rates, injuries, illness linked to bad working positions and heavy loads transport, decrease manpower and material costs as well as reducing construction labor costs in the building field!

This low work station offers a lot of advantages for safety by preventing the worker from falls risks from a high position, as there no need to be on the form work beams or on the frame to erect it, even for covering with the plywood.

Working safely from the floor and lifting up no load higher than 1.40 meter have proven to drastically increase the productivity and to decrease production labor costs, by reducing tiredness, and allowing faster operations and easier manipulation of the loads.

TS15

4. Knowledge-based ergonomic assessment of working conditions in surgical ward

Joanna Bartnicka – Silesian University of Technology, Poland

This article aims to identify the mechanisms of knowledge management in the selection and integration of ergonomic methods for the evaluation of working conditions of nursing staff and surgeons on surgical wards. The criterion for the choice of a given category of work specified for individual workstations based on the results of empirical research.

There were established procedures of the ways for integrating methods and tools depending on the appointed category of work. In the study there were used such ergonomic methods and evaluation factors as: OWAS, REBA, RULA, NIOSH, monotype tasks, energy expenditure and computing tools: 3D Static Strengh Prediction Program 3D SSPP, Energy Expenditure Prediction Program EEPP, Anthropos ErgoMax, CAPTIV L2100. In addition the tools of competence matrix and decision tables are used to identification the category of work as well as to selecting an integrated ergonomic assessment.

The presented research methodology of ergonomic assessment has been performed within the continuation of work on the development project titled: Knowledge-based shaping of working conditions in health care units, funded by the National Centre for Research and Development in Poland. The aim of the project was to establish

a computer system based on ICT technologies for supporting hospital processes, which was called "Virtual hospital".

Keywords: Integration of ergonomic assessment, surgical ward, work categorization, CAPTIV software

TS15

5. VDU work in control rooms – a study on the implementation of ergonomic guidelines

Martina Bockelmann, Friedhelm Nachreiner – Society of Occupational, Industrial and Organizational Psychology Research (GAWO), Peter Nickel – Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA), Germany

Production and services are usually monitored and controlled via control centres with several computer-based visual displays and control units (VDU). Operators thus perform VDU work according to European Directive 90/270/EWG on work with visual-display-units. The provisions given in this directive for design are relevant and binding for ensuring a minimum standard of OSH. Guidelines for the ergonomic design of VDU work in the office sector, however, cannot directly be transferred into process control activities. This is because of substantial differences in the tasks to be performed and the processes controlled. Initiated by the FIOSH, Germany, GAWO and IFA have conducted a study on the current state of VDU work in control centres across different industries and services. Requirements derived from the directive and related literature resulted in recommendations for the evaluation and possible action for an ergonomic design of VDU work in control centres.

Field studies in 24 German control centres covered two work-shifts each and were carried out from 10/2010 to 01/2011 in sectors such as production, energy, traffic management, security services, telecommunications and media. A comprehensive checklist with 274 items was developed for these studies, covering work-system components (EN ISO 6385), i.e. environment, displays, controls; with special emphasis on human-machine-interaction.

In general about two-thirds of the requirements have been fulfilled. Some basic ergonomic requirements are usually met; i.e. keyboard layout, workplace access. However, the design of e.g. relative humidity or arrangements of VDUs often failed to meet the requirements. Analyses revealed that recommendations for possible action are especially important with regard to the design of human-machine-interaction-interfaces. Major flaws were

identified for key issues such as information presentation or especially dialogue design, e.g. individualization, self-explanation and error tolerance. Based on the results and available recommendations, guidelines for the design/redesign of VDU work in control rooms have been developed.

TS15

6. Injures prevention in hospitals: considerations about space safety and usability in bathrooms

Edda Capodaglio – Fondazione Maugeri, Italy

Safety and ergonomics of the hospital design are basic requirements vouching for both patients' and operators' health. In particular space adequacy and accessibility of bathrooms are critical whenever dealing with patients' disability, motor impairments, or use of devices. Current laws settle space dimensions and features for the design of bathrooms in the hospital, facing also accessibility, safety and autonomy. Nevertheless bathrooms leap very often as the unsuccessful side of the hospital buildings.

In a private hospital of northern Italy, 32 bathrooms of a rehabilitation unit were surveyed, reckoning dimensional and technical factors possibly connected to risk of injury. Bathrooms' surface area varied among m^2 2.7 and 6.6 (mean m^2 4.2 ± 1.2), in 8 cases smaller than the normative reference value. Bathroom's entry was in most cases hindered by furniture or by prominences, 5 doors didn't reach 90° opening, and 7 had a wide span below the normative value.

Fit space for devices was assessed: 5 bathrooms were completely not accessible with any device; wc was accessible in 10 cases with a wheelchair, in 3 cases with a mobile lifting device, in 26 cases with a wheeled hygienic chair.

Furniture's type and quantity was considered relative to autonomous or assisted use of the bathroom.

The study brought conclusions about safety and usability: spaces were not designed to meet functionality; sanitary furnishing displacement doesn't promote fully patient's independence; some basic safety components are lacking; risk of injures could be enhanced by lack of clarity of some items, or by low level of comfort inducing inappropriate behaviors in patients or operators. Special risky conditions could be induced by factors such as poor ergonomics, reduced dimensions, presence of obstructions, inadequate furnishings, unfit space for devices.

While organizational and individual factors are deeply considered in healthcare safety, space design and accessibility are often confined on a minor side, undermining basic safety issues. Ergonomics should be implemented to overrun these adverse situations.

Parallel session TS16: Safety theories and models

TS16

1. Occupational safety theories, models and metaphors in the three decades since World War II

Paul Swuste, Coen van Gulijk – Delft University of Technology, Walter Zwaard – Trainer and Consultant, Delft, Yvette Oostendorp – Advisory Council on Hazardous Substances, The Netherlands

This article is third in a row of articles discussing the development of theories, models, and metaphors in the safety science domain. Previous articles have been published in Safety Science.

In the period after World War II till the beginning of the 1970s, one theory on accident causation, one model of the accident process, and four analytical techniques have been developed in the domain of safety science.

Willem Winsemius, a Dutch physician, is the father of the "task dynamics theory". The 1951 theory explained and predicted accidents from reflex reactions and improvisations of workers during process disturbances and unexpected events. British observational research on more than 2000 accidents has also shown the relationship between tasks, actions, and accidents. Like Winsemius, here too, ergonomic (re)design was seen as the key to prevention of accidents. According to these researchers, inadequate management support was also one of the attributing factors in accident causation. Furthermore, the research showed that regulations and laws did not have a tangible effect on the incidence of accidents.

The model of the accident process was based upon the so-called "epidemiological triangle", applied to the field of safety science, and known as the "hazard – barrier – target model". The model was a reaction on the poor quality of the safety science research till then, and the limited results achieved in the reduction of accidents. William Haddon Jr., an American physician, was the name connected to this model and to the logical classification of ten prevention strategies, which were organised hierarchically.

The focus on causes of accidents and its prevention was changing from behavioural the victim via task to management causes. The process industry was starting in the period after World War II. Processes had become more complex, but were still rather unstable and "loss of containment" was occurring frequently. This growing complexity was also visible in the military industry. In this sector in America a number of techniques were developed to

increase system reliability. These techniques were not based upon systematic research, but a coded collection of practical experiences.

The accident proneness theory and the focus on human failures were still remaining popular in the occupational group of safety officers, based upon the information of the volumes of the Dutch professional journal on safety "De Veiligheid". During the period of 1945–1974 the professional journal did not pay attention to safety techniques. With the exception of one paper, all publications were dealing with personal safety issues.

TS16

2. Valuation of safety?

Jouko Heikkilä, Päivi Hämäläinen – VTT Technical Research Centre of Finland, Sari Tappura – Tampere University of Technology, Finland

Safety has an essential place as a highly prioritized value in the classical Maslow's hierarchy of human needs. But can we define the value of safety based on that theory? What is a true value of safety? Value is typically counted by money but counting monetary value of safety is not so obvious. How safety is then valued in practice in business and industry? Earlier Safety First and recently Zero Accident movements place safety first at any cost – in principle, at least. On the other hand, the risk assessment view of safety applies ALARP criteria ("as low as reasonably practicable") for scaling costs and benefits of risk reduction. Even Reason has described organisations oscillating between two potential ends: one of them being bankruptcy because of too much protection and the other one a catastrophic accident. Do these different views on valuation of safety create possibly unsolvable conflicts when safety and business are managed? Does the demand to give safety a value as such without any monetary calculations drive the business decision makers to see safety only as a cost? Or do they see safety as a part of the corporate social responsibility enhancing valuable trust of the stakeholders and the reputation of the company? Does the risk assessment approach lead to too simplistic view of safety? What other possibilities exists? How safety could and should be valued in decision making?

The objective of this paper is to discuss these questions. On the basis of the literature study we present the current status of the topic. New alternatives and scenarios of valuation of safety are presented. They are formulated and evaluated in workshops together with researchers, company representatives and other stake holders and they will form a vision and the roadmap for on-going development and research work.

TS16

3. Reflecting on Jens Rasmussen's legacy

Jean-Christophe le Coze – French National Institute for Industrial Environment and Risks (INERIS), France

Jens Rasmussen, a pioneer in the field of safety science (with a focus on major accident research), remains a contemporary writer because of the lasting influence of his models and the ambition of his research program. The idea of this article is to look back on Jens Rasmussen contribution. First, the paper offers an overview of his key contributions over 30 years of cross disciplinary publications. Methodologically, I have reviewed about 30 papers in order to extract key inputs for the field of safety. This overview shows the evolution of his intellectual journey, from cognitive models, interface design, through human error definition and human reliability, accident investigation to socio technical modelling. Several scientific disciplines are involved, including engineering, psychology, safety management, and across these disciplines, cybernetics.

Second, the article shows how his thoughts have been very influential and are therefore still present in the writings many authors in the field, indicating the influence of these ideas in the background of more recent ones. Authors with different disciplinary influences (e.g. psychology, management, sociology) and orientations in the field of safety (accident investigation, safety assessment, man-machine interface) have indeed incorporated in different ways some of Rasmussen's ideas into their studies, related to different stages of his own developments. While doing so, they use, extend or criticise some of these ideas. Third, what culminated in what is defined here, as Rasmussen's "strong program for a hard problem", is analysed as stemming for a good part from an influential intellectual matrix: cybernetics. Fourth, after identifying in hindsight some of the limits in Rasmussen's program, several new orientations are proposed. They initiate a "constructivist turn".

TS16

4. To describe or to prescribe? Or both?

Jean-Christophe le Coze – French National Institute for Industrial Environment and Risks (INERIS), Romuald Périnet, Nicolas Herchin – GDF SUEZ, Philippe Louys – GRT GAZ, France

The aim of this presentation is to introduce an ongoing collaboration, and some of its results, between INERIS, GDF SUEZ and GRT GAZ for the design and implementation of a strategy for introducing and managing human and organisational factors within a large technical system, a high pressure gas transmission network. Little is actually published about how to shape a human and organisational factors strategy based on sound principles derived from scientific research in different fields such as cognitive

psychology, ergonomics, sociology and (safety) management. These disciplines have different philosophies when it comes to action. Although one finds him/herself at the heart of the project of safety when doing so, there is literally no guidance (or not much) about how to proceed. Yet, a description of activities obtained from a research strategy based on observations and interviews with operators, engineers and managers, does not lead directly to a prescription of how to improve situations. There is a process of translation that is implicit rather than explicit, and sometimes even absent from the scientific literature, depending on the disciplines. Very often, this is however what companies have in mind when they open their doors to external observers, i.e. to improve safety. The move from the outsider position to the insider one, shaping companies practices, can raise much concern for researchers. But, if the gap between descriptions to prescriptions is difficult to bridge, it doesn't mean that it can't be at least addressed and made more explicit. Different options can be expected on this issue, with sometimes compatible and sometimes incompatible research postures between disciplines. This is a very important topic. In order to clarify it, the paper will present results from fieldworks at different levels, in relation with the problem of translating them into practical, prescriptive actions for the company.

TS16 5. Robustness and the organizational invisibility of operational work

Petter G. Almklov – Norwegian University of Science and Technology (NTNU Social Research), Stian Antonsen – Safetec Nordic, Norway

Inspired by a study of safety effects of New Public Management (NPM) reforms in Norwegian critical infrastructure sectors this paper suggests that the discourse of work found in NPM and more generally in the public and private sectors, leads to an erasure of informal practices of importance for safety and robustness. We demonstrate this by discussing how organizational models based on this understanding of work meet the operational work of continuously operating infrastructures.

We demonstrate how the operational work of continuously running an infrastructure or similar complex systems over time is characterized by the importance of a) articulation work: the situational coordinative work of making procedures work in actual contexts and of aligning tasks and resources and b) continuity: the system and the group of workers have a joint history that influences the execution of each task. We suggest that these aspects of work are largely invisible (to the formal organizational systems), but crucial to the robust operations of the infrastructures. This is an observation that is supported by findings in literature in (amongst other) Resilience Engineering and HRO framework, that

all stress the importance of the dynamic situational competent maneuvering in upholding robust operations.

There is a misalignment of the production centered understanding of work within NPM with essential element of what operational work consists of (in these settings). This is a key to understand much of the tension and potential safety concerns associated with NPM-inspired restructuring of infrastructure sectors. More generally our paper suggests that, though it has definite advantages, organizing work as the production of simple standardized outputs, may not always capture essential elements of operational work, and may harm important robustness creating factors. Also, it can harm informal networks and communication channels that can be important for risk sensitivity and crisis response.

Parallel session TS17: Safety and health of vulnerable workers

TS17

1. Horizontal career changes as an alternative to premature exit from work

Paula Aleksandrowicz, Frauke Jahn, Hanna Zieschang – Institute for Work and Health of the German Social Accident Insurance (DGUV), Dietmar Bräunig – University of Giessen, Germany

Certain workplaces are so-called "jobs with limited tenure". Due to task-contingent psychosocial or physical risk factors, often coupled with qualification mismatches, workers cannot grow old in them. That may lead to premature exit into retirement, to a period of drawing the work incapacity pension or to a long spell of unemployment. A horizontal change of career or task enables the worker to move on to a less burdening workplace while preserving his or her social and financial status. E.g., a nurse in inpatient care could change her task to Diagnosis-Related Group (DRG) manager and remain with the same employer, or undergo qualification and take on the job of a ward secretary in another hospital (Jahn, Ulbricht 2011).

The Institute for Work and Health has started in December 2011 a project financed by the German Federal Ministry of Labor and Social Affairs – "Horizontal career change – a new job opportunity for older employees". Its objective is to develop a model of career changes for workers employed in jobs with limited tenure and to implement it in form of an information and communication technology (ICT) based tool. Based on individualized input (e.g. information on accomplished training, skills gained in voluntary work, health indicators), the tool would recommend alternative horizontal career tracks and provide information on occupational re-training needed in order to reach the given job. Possible applications range from individual career planning, through institutionalized career planning and vocational re-integration, to personnel development and deployment in small and medium-sized enterprises (SME).

Keywords: Older workers, premature exit, retirement, horizontal career, personnel development, ICT tool

TS17

2. Risks to young people at work. More experience or less exposure?

Martin Damen, Rebecca Wouters, Peter Berkhout – RIGO Research & Advies, Linda J. Bellamy – White Queen BV, Martijn Mud – RPS, Henk Jan Manuel – National Institute for Public Health and the Environment (RIVM), Joy Oh – Ministry of Social Affairs and Employment, The Netherlands

Workers under 25 (17% of all Dutch workers) are involved in 22% of occupational accidents with at least one day absence of work. In this paper we examine if this can be explained by just age or also by other factors and how sensitive the risk is to changes in exposure to occupational hazards. We do so to decide which strategy, either increasing human capital (making young people less vulnerable) or strict regulation (keeping young workers away from exposures) can be more successful.

To do so we use an exposure to hazards survey from 2011 containing the total annual exposure in hours for over 60 occupational hazards (like "working on a placement ladder"). This 2011 survey also contains the respondents occupational accidents during the last 12 months. We also use the Storybuilder analysis of 18.000 serious occupational accidents reported to the Dutch labour inspectorate from 1998 to 2009.

In this paper we will first identify if young workers have a different exposure profile compared to other workers and how this profile relates to the number of observed accidents. We will then construct an empirical model to explain the observation of accidents given personal characteristics (including age) on the one hand and exposure on the other. This (count) model makes use of the distinction between not having an accident (a so-called zero observation) with no hazard present and not having an accident with hazards present. This results in a factor that could be described as "accident prone" or "vulnerability".

Based on our estimation model that explains the occurrence of accidents in relation to age and other background variables on the one hand and exposure profiles on the other we conclude that the strategy of increasing human capital is to be preferred (that is: has to most room for improvement) and especially for young women. The regulation strategy can be considered in situations where young workers are exposed to many hazards simultaneously. That is: reducing the number of hazards, not necessarily the duration of the exposure.

TS17

3. Increased occupational risks among migrant workers in Austria

Dominique Dressler – ISSA International Section for the Prevention of Occupational Risks in the Iron and Metal Industry, Austria

Statistical data of the Austrian Social Insurance in 2007 have shown increased work accident rates in Turkish workers compared to Austrian workers in high risk sectors, whereas their work accident incidence was only slightly higher than that of Austrian workers in a lower risk sector such as hotels and restaurants.

The social insurance data examined showed that Turkish citizens had an accident rate of 13.6% compared to 8.8% for Austrian workers in the construction sector and of 10.5% compared to 4.5% for Austrian workers in the metal industry, whereas the accident rate was of 4.1% for Turkish workers compared to 3.8% for Austrian workers in the hotel and restaurant sector.

Key words: Migrants, occupational risks, work accidents

TS17

4. National differences in safety practice

Sisse Grøn – Centre for Maritime Health and Safety, University of Southern Denmark, Denmark; Gichelle Cruz – University of the Phillipines, Philippines

According to statistics Filipinos working on Danish ships experience fewer work accidents than their colleagues. In an ongoing project, we are trying to find out what lies behind the figures. The first step of the project is a review of recent studies on the relationship between nationality and safety.

Studies on the following topics have been collected over a time span of some years: national differences and safety; minority workers' occupational health and safety; multicultural crews in seafaring; and underreporting of work accidents at sea. The studies have been collected by various means, including database searches. The 31 studies included have been selected for their relevance, and not as the result of a systematic criteria based quality assessment.

Language, a healthy migrant effect, and underreporting seem to be the most important causes of the differences between nationals.

The reviewed studies confirm that there is no reason to believe that employees' ethnic or national background determines their safety practice, all things being equal, mainly

because things are never equal. If we are to believe the reviewed studies, it is not the minority or migrant status, as such, which makes employees vulnerable, but more likely convergent factors.

TS17

5. Age and gender differences in work ability from industry workers: the foundation for the safety intervention design

Cláudia Fernandes – Technological Center for the Metalworking Industry (CATIM), Anabela Pereira, Pedro Bem-Haja, Vânia Amaral, Carlos Silva – University of Aveiro, Portugal

The paper explores and analyses the age and gender differences relating work ability in active workers from the Portuguese industry, aiming to achieve general trends that allow the industrial safety design to be based on evidence from research. It were encompassed 621 workers (386 men and 235 woman) with ages between 20 and 65 years old. It was used the Work Ability Index (WAI) to measure the individual work ability.

The data show that generally the WAI decreases with age, and data visual analyses suggests that there are some periods in life that differences between genders are more pronounced. The workforce vulnerability age bands identified according to gender are: i) 25-34; ii) 40-44 and iii) 60-64.

The main reasons for work absence and its duration between genders are also distinct according to the age band in analyses. The men propensity is higher for accidents that lead to lesions in legs/foots and upper limbs, and on the other hand women show more back injury from accident and musculoskeletal injuries related to work and are diagnosed more commonly with slight mental disorders or problems (for example, slight depression, tension, anxiety, insomnia). If we look into the absence to work duration, there are some patterns that are different between genders, e.g. absence superior to 100 days per year are only present in women in the bands 25–34 and 40–44; on the age band 40–44, 33% of the women have from 1 to 24 day absence per year and men 28%, 67% of the women and 72% of the men didn't miss work. Some of the trends identified might be consistent with maternity leave and family support, accident and sickness vulnerability. General directions for maximizing industrial safety interventions results arise and are discussed in this study, namely the resilience engineering approach aiming the design of healthy workplaces.

Keywords: Work ability, safety intervention design, resilience engineering, healthy workplaces, work-life balance

Parallel session TS18: Safety interventions and improvement programmes

TS18

1. Risk Process Management Evaluation Methodology. Case study in Brazilian Oil and Gas Downstream Industry

Eduardo Calixto – Federal University of Rio de Janeiro, Carlos Daniel, Cid Atusi, Wilson Alves – Petrobras, Brazil

The main objective of this study is propose a new Risk Process Evaluation Methodology to enable improvement on Risk management based on critical issues which will be identified by audit regarding factors like Planning, Risk Analysis, Recommendation, Risk Communication and Risk Follow up. The new methodology is based on Brazilian National Quality Award concepts that focus on quality management. The Risk Process Methodology aim to identify: the main improvements opportunities, drawbacks as well as good practices in risk management. Thus, several Managements which are responsible for enterprises risk management in different enterprises phases will be audit and employees from those management also audit one each other. Basically eleven ten analysis specialist from different refineries and headquarter office will perform audit in group of two. Consequently, learning throughout Organization teams will be proceeding by audit process. In addition, based on audit results there will be discussed about correlation between Risk Process Management factors to support future decisions to improve Risk Process Management as a whole.

Key words: Safety process, risk management, audit.

TS18

2. Systematic retrieval of studies on work safety interventions

Angelika Dziekanska, Johnny Dyreborg, Elizabeth Bengtsen, Pete Kines, Anne Rohde, Pernille Pedersen, Anne Holm – National Research Centre for the Working Environment, Denmark

The vast amount of safety science literature might offer important information for prevention of accidents at work. As the data on this literature are catalogued in several databases the retrieval requires systematic search strategies. In order to support health and safety researchers, practitioners and other experts we searched scientific literature on the effects of safety interventions for the prevention of accidents at work. This literature

search was a part of a Campbell Collaboration systematic review. The aim of the paper is to develop relevant search strategies and evaluate which databases provide useful literature on safety intervention for the prevention of accidents at work.

Methods. A search strategy based on MEDLINE has been developed and modified to fit other relevant databases, such as Embase, CINAHL, OSH ROM, PsycInfo, and Web of Science. We have developed trial filters that allow non-randomised studies and simple before and after studies to be included in the literature search, on the basis of Cochrane's highly sensitive Search Strategy for identifying randomized trials in MEDLINE. The search strategy in this review is developed taking into account both sensitivity and specificity of the searches as well as the resources allocated to this review project.

Results. In total 29,914 titles were found with the developed search strategy. After removal of duplicates and screening of the titles the number of relevant titles was reduced substantially. The results showed that safety science literature have to be searched in a number of databases in order to cover the field adequately. The paper will suggest relevant search criteria for finding safety intervention studies in various databases.

TS18

3. Decision making as articulation work in fish farming disease control

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In the Norwegian fish farming industry effective proactive and reactive disease control is a key sustainability challenge. Diseases are of the most important hazards for losses of production and for environmental harm, especially to wild fish, and are an important challenge for the industry. This paper draws on data from a project investigating how modelling and simulation based tools may support disease control in fish farming. Decision making in fish farming is best described as a situation where articulation work and situation awareness rests on the ability to integrate information from a wide spectrum of sources with high uncertainty, but also where acting on information implies mobilizing tightly coupled networks of interdependencies representing constraints and opportunities for action. While decision making under risk is typically portrayed and theorized in "closed contexts" like airline cockpits and control rooms, we here discuss "open" decision contexts. We describe some of the work of situating information in concrete decision contexts, and the need to align information and resources for action within the specific constraints and opportunities provided by these. High uncertainties, both in terms of understanding incumbent threats and the outcomes of different strategies and remedies, further

complicate the decisions. The mobilization of resources for disease control offers many of the coordination problems seen in response to public crises (see e.g. McConnell and Drennan, 2006; Auerswald et al, 2006). We also build on the theorizing of coordination within sociology of work, and on decision theory. We discuss the possible contribution of modelling tools to support these decisions, and argue that they should not black box interdependencies and connections; rather create necessary transparency for effective responses.

TS18

4. A qualitative evaluation of simulator training in an offshore anchor handling environment

Atle Ødegård, Jon Ivar Håv old, Steinar Nistad – Åalesund University College, Norway

Anchor handling is one of the most demanding and dangerous tasks performed in the maritime service industry. Aalesund University College and Offshore Simulation Centre in Aalesund Norway has in cooperation developed a training concept for crew on anchor handling vessels. One of the three courses in the concept is a Crew Resource Management (CRM) course named Strong Teams (ST). In the period from 2005 to 2008 around 500 seafarers has completed the ST course.

Barnett et al. (2003) says that only one question ought to be asked if one is training people: How effective is this training? Several methods of training evaluation are possible, including observation, questionnaire, interview and reflective diaries, however, in this research individual semi-structured in depth interviews were conducted with six crew members and two ship-owner representatives. A structured interview guide using Steinar Kvale's (2008) recommended seven steps were developed, and the data were analysed.

The purpose was to explore four research questions:

1. How was information on ST before attendance on the course evaluated, and what attitudes were common at the beginning of the course?
2. How were content, structure and pedagogical approach of the course received?
3. How important was it that the training was based on simulators?
4. What was the learning effect of the training?

For each of the above research questions recommendations of improvements based on evaluations by the interviewed seafarers and ship-owner representatives were made.

TS18

5. ICT based shaping of working conditions in health care

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The article presents the results of research on using modern ICT tools in the trainings for medical staff in the area of creating ergonomic conditions on the surgical ward.

The crucial essence of the proposed training based on life-long learning is the ability for the access to knowledge recourses at the time when they are needed. Technologies that enable such access are the following: Internet technologies – Content Management System CMS, Geographic Information System GIS Augmented Reality AR and Radio Frequency Identification RFID. The methodology for the preparation of training materials adapted to these technologies was established and the examples of training scenarios with their use were presented. There was indicated the special attention to issues related to knowledge management in the process of creating the training content and forms of presentation of information, which are adjusted to the perceptual capabilities of users.

Keywords: Working conditions, health care, ICT, virtual environment, knowledge repository

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